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PALÆONTOGRAPHICAL SOCIETY.

v. 6
FOSSIL CORALS OF GREAT BRITAIN.

PART III.

FOSSIL BRACHIOPODA

OF

GREAT BRITAIN.

PART I.—TERTIARY SPECIES,

AND

PART II.—CRETACEOUS SPECIES.

FOSSIL SHELLS OF THE LONDON CLAY.

PART II.

FOSSIL RADIARIA

OF THE

CRAG AND LONDON CLAY FORMATIONS.

1852.

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A MONOGRAPH
OF THE
BRITISH FOSSIL CORALS.

BY

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VIENNA, KONIGSBERG, MOSCOW, BRUXELLES, HAARLEM, BOSTON, PHILADELPHIA, ETC.,

AND

JULES HAIME.

THIRD PART.

CORALS FROM THE PERMIAN FORMATION AND THE MOUNTAIN LIMESTONE.

LONDON:

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

1852.

A. MORGAN

BRITISH FOREST COMMISSION

REPORT

ON THE PROGRESS OF THE COMMISSION DURING THE YEAR 1894-5
AND ON THE STATE OF THE FOREST RESOURCES OF THE KINGDOM
IN 1895

JOHN HAYES

CHIEF CLERK

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DESCRIPTION

OF

THE BRITISH FOSSIL CORALS.

CHAPTER XIII.

CORALS FROM THE PERMIAN FORMATION.

VERY few Fossils belonging to the great Zoological group of Polypi have as yet been discovered in the Permian Formation. Only five species have been met with in England; and we are entirely indebted to Professor William King for the knowledge of these Corals. We have not been enabled to study them ourselves, and we must therefore beg leave to lay before our readers the descriptions given by that distinguished Palæontologist; but in so doing, we deem it necessary to differ somewhat from the author of the valuable '*Monograph of the Permian Fossils of England*,' respecting the natural affinities of these Zoophytes. The species referred by Professor King to the genera *Calamopora*, *Stenopora*, and *Alveolites*, appear to have all the exterior characters of *Chætetes*; and we are, therefore, inclined to class them in that generical division: the two other species probably belong to the family of the *Stauridæ*, and, in our opinion, form part of a small genus that Professor King had, in 1849, very properly proposed establishing under the name of *Polycalia*, but has abandoned since that time.

Family FAVOSITIDÆ, (*Introduction*, p. lx.)

Genus CHÆTETES, (*Introduction*, p. lxi.)

1. CHÆTETES? MACKROTHI.

CALAMOPORA MACKROTHII, *Geinitz*, *Grund.*, p. 582, 1846.

STENOPORA INDEPENDENS, *King*, *Catal. of the Organic Remains of the Permian Rocks*, p. 6, 1848.

— CRASSA, *Howse*, *Trans. of the Tyneside Nat. Field Club*, vol. i, p. 260, 1848, (not Lonsdale?).

STENOPORA MACKROTHII, *Geinitz*, *Verst. der Deutsch. Zechst.*, p. 17, tab. viii, fig. 10, 1848.

CALAMOPORA MACKROTHII, *King*, *Permian Fossils of England*, p. 26, tab. iii, figs. 3—6, 1850.

CHÆTETES? MACKROTHI, *Milne Edwards and Jules Haime*, *Pol. Foss. des Terr. Palæoz.*, p. 274, 1851.

“A branching Calamopora: with numerous slender, round or polygonal, transversely-wrinkled tubes, rising perpendicularly in the centre of the branches, and afterwards suddenly curving out to the surface. Interpolated or new tubes numerous, originating on the outside of the old ones. Margin of the apertures with from five to eight spine-like tubercles.

“It is rather a common Coral, being found at Tunstall Hill, Humbleton Quarry, Dalton-le-Dale, Ryhope-Field House Farm, and Whitley, in the Shelly Limestone. The German localities, according to Schlotheim and Geinitz, are Milbitz and Corbusen, in the Lower Zechstein; and Glücksbrunn and Liebenstein, in the Zechstein Dolomite.” (*King*, loc. cit.)

2. CHÆTETES? COLUMNARIS.

CORALLIOLITES COLUMNARIS, *Schlotheim*, *Taschenb. für die Ges. Miner.*, p. 59, 1813.

— — — — — „ *Akad. Münch.*, vol. vi, p. 23, pl. iii, fig. 10, 1820.

STENOPORA INCRUSTANS, *King*, *Catal. of the Org. Rem. of the Permian Rocks*, p. 6, 1848.

— COLUMNARIS, *King*, *Perm. Foss. of England*, p. 28, pl. iii, figs. 7, 8, and 9, 1850.

CHÆTETES COLUMNARIS, *Milne Edwards and Jules Haime*, *Pol. Foss. des Terr. Palæoz.*, p. 274, 1851.

“An incrusting Stenopora. Polypidoms tubular, cylindrical, slightly wrinkled more or less transversely, and in close contact, except towards their orifice, where they are a little reduced in diameter, leaving rather wide interspaces, which are often perforated with interpolated tubes. Apertures circular or slightly polygonal, with a tuberculated margin.

“It occurs at Humbleton, Tunstall Hill, and Whitley; but is nowhere a common species. *Geinitz's Alveolites producti*, which may be the same Coral, is found at Corbusen, in Saxony.” (*King*, op. cit.)

3. CHÆTETES? BUCHANA.

ALVEOLITES BUCHANA, *King*, *Perm. Foss. of England*, p. 30, pl. iii, figs. 10, 11, & 12, 1850.

CHÆTETES BUCHANA, *Milne Edwards and Jules Haime*, *Pol. Foss. des Terr. Palæoz.*, p. 274, 1851.

“Tubes or cells adjoining, cylindrical, leaning, concavely arcuate ascendingly, alternately overlying each other, and slightly wrinkled more or less transversely. Apertures regularly arranged, circular, occasionally polygonal, margined by a circle of from twelve to fourteen small, closely-packed tubercles, which generally fill up the interspaces.

“It is a scarce fossil, having only occurred to me once in the Shell Limestone at Humbleton Hill Quarry.” (*King*, op. cit.)

Family STAURIDÆ, (p. lxiv.)

Genus POLYCÆLIA.

This genus, the establishment of which was proposed by Professor King some years ago, was characterised by that author in the following terms :

“ A simple Cyathophyllida. Form conical. Walls solid. Primary vertical plates converging to within a short distance of the centre. Secondary vertical plates reaching about half way to the centre. Transverse plates horizontal, at irregular distances from each other, and extending quite across the cavity. Chambers or lamellar interspaces capacious compared with those of other Cyathophyllidæ. Reproduction within the polypiferous cup.” (*King*, ‘Ann. and Mag. of Nat. Hist.,’ Second Series, vol. iii, April, 1849.)

As we have stated here above, the genus Polycælia has of late been abandoned by Professor King; but it appears to us that it ought to be adopted, and in the systematic arrangement of the polypi, published by ourselves in 1851, it has been included in the family of the Stauridæ. (See ‘Monographie des Polypiers Fossiles des Terrains Palæozoïques, Précédée d’un Tableau Général de la Classification des Polypes,’ p. 162.)

1. POLYCÆLIA DONATIANA.

TURBINOLIA DONATIANA, *King*, Cat. of the Org. Rem. of the Perm. Rocks of Northumberland and Durham, p. 6, 1848.

CALOPHYLLUM DONATIANUM, *King*, Perm. Foss. of England, p. 23, pl. iii, fig. 1, 1850.

POLYCÆLIA DONATIANA, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 317, 1851.

“Calophyllum vermiform; gradually enlarging from the base upwards; transversely wrinkled and longitudinally striated on the outside. Vertical plates dense and somewhat apart from each other; primaries four; secondaries sixteen. Transverse plates horizontal, rather thick, and at irregular distances from each other. Polypiferous cell shallow.

“The specimen figured, which is the only one of the species known to me, was procured at Humbleton Hill, in the upper bed of shell-limestone.” (*King*, ‘Perm. Foss. of England,’ loc. cit.)

2. POLYCÆLIA PROFUNDA.

CYATHOPHYLLUM PROFUNDUM, *Germer*, Verst. des Mansf. Kupfer Schiefers, p. 37, 1840.

— — — *Geinitz*, Neues Jahrb. für Miner. Geol., 1842, p. 579, tab. x, fig. 14.

PETRAIA DENTALIS, *King*, Cat. of the Org. Rem. of Perm. Rocks of Northumberland and Durham, p. 5, 1848.

CYATHOPHYLLUM PROFUNDUM, *Geinitz*, Verst. des Deutsch. Zechst., p. 17, tab. vii, fig. 17, 1848.

CARYOPHYLLIA QUADRIFIDA, *Howse*, Trans. of the Tyneside Nat. F. C., vol. i, p. 260, 1848.

PETRAIA PROFUNDA, *King*, Perm. Foss. of England, p. 23, tab. iii, fig. 2, 1850.

POLYCÆLIA PROFUNDA, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 317, 1851.

“Form conical, and slightly curved. Cavity deep and longitudinally furrowed. Plates of two lengths, the longest five or more in number, plain edged (?), and reaching half way to the centre; the shortest from one to four in number. Lamellar interspaces with two very finely denticulated, slightly prominent ridges.

“I have only succeeded in procuring two or three specimens from the shelly magnesian limestone at Humbleton Quarry. Geinitz states its having been found in the lower Zechstein at Eisleben, Ilmenau, Gerbstedt, and between Hettstädt and Leimbach.” (*King*, op. cit.)

Aulopora Voigtiana, *King*, op. cit., p. 31, pl. iii, fig. 13, appears to be a BRYOZOOM.

CHAPTER XIV.

CORALS FROM THE MOUNTAIN LIMESTONE.

THE Fauna of the Mountain Limestone Period is one of the richest in true Polypi; seventy-six species have already been found in the deposits appertaining to this geological division, and the presence of none of these Corals has, as yet, been satisfactorily proved in beds belonging to any other period. Forty-three of these species are British, and they are referable to six families:—Milleporidæ, Favositidæ, Seriatoporidæ, Auloporidæ, Cyathaxoniidæ, and Cyathophyllidæ; but the Favositidæ and the Cyathophyllidæ are the forms which have the most numerous representatives among these Fossils.

The principal localities from which they have been obtained, are Castleton, Bakewell, Oswestry, Derbyshire, Bolland in Yorkshire, Masbury, near Mendip, in Somersetshire, the environs of Bristol, Kendal in Westmoreland, Wellington in Shropshire, Mold, Lilleshall, Frome, Clifton, &c., in England; the Isle of Man; Armagh, Enniskillen, Kulkeag (Fermanagh), Wexford, and Easky (Sligo), in Ireland.

Most of the Carboniferous Fossils that we have represented in the plates joined to this Monograph, belong to the Collections of the Geological Society of London, the Museum of Practical Geology, under the direction of Sir Henry De la Beche, the Museum of Bristol, and the rich Cabinet of our esteemed friend J. S. Bowerbank, Esq. We much regret not having been able to obtain the same liberal aid from the Museum of the University of

Cambridge, and to have been therefore obliged to omit representing in this work a certain number of species that we have not seen in any of the numerous collections so generously placed at our disposal by the great majority of the English Geologists. But the omission that we here allude to is now of less importance than it appeared to us, when our application to the Cambridge Museum was rejected, for, since that time, a young Palæontologist belonging to that scientific establishment, Professor M'Coy, has published very good figures of almost all the Corals that we were desirous of obtaining communication of from the above-mentioned Museum. His recent work¹ will enable us, at least, to complete our Catalogue of the Corals found in the Carboniferous Formation of Great Britain; and having gone to Cambridge in order to see the fossils described by that gentleman, we have easily recognised those species which we had already met with elsewhere, and can without hesitation refer most of the others to generical divisions here adopted.

Family MILLEPORIDÆ, (p. lviii.)

1. *Genus* FISTULIPORA, (p. lix.)

1. FISTULIPORA MINOR.

FISTULIPORA MINOR, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d Series, vol. iii, p. 130, figs. *a*, *b*, 1849.

— — *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 220, 1851.

— — *M'Coy*, Brit. Palæoz. Foss., p. 79, pl. iii B, fig. 12, 1851.

“Cell-tubes with slightly prominent margins at the surface, about four in the space of one line, rather less than their own diameter apart, the intervening space composed of from one to three rows of the minute vesicular cells. The diaphragms in the main tubes slightly irregular, about half their diameter apart; the tubes are from half a line to nearly an inch in length, according to the age of the example, but not altering, materially, their diameter or relative distances.

“Not uncommon in the Carboniferous Limestone of Derbyshire.” (*M'Coy*, Brit. Palæoz. Foss., loc. cit.)

¹ Description of the British Palæozoic Fossils in the Geological Museum of the University of Cambridge, by F. M'Coy. This work was published in May, 1851, some months after the first part of our ‘*Monographie des Polypiers des Terrains Palæozoïques*,’ and at least a year after the distribution of the first part of our ‘Description of the British Fossil Corals’ to all the members of the Palæontographical Society. In the beginning of his book (p. 17), Professor M'Coy expresses his regret at not having become acquainted with the latter publication early enough to be able to refer to it; and we feel much gratified in seeing, that the results which Professor M'Coy appears therefore to have obtained solely from his own observation, are often so very similar to those published by ourselves a year before; even by a singular coincidence, he often makes use of the same names for the divisions previously established in the first part of this Monograph.

We have not seen any specimens of this fossil Coral, which constitutes, together with the following species, a small genus nearly allied to *Propora*¹ and *Lyellia*.² In a memoir published in the 'Annals of Natural History' (1849), Professor M'Coy pointed out the existence of infundibuliform tabulæ as being one of its characters, and figured them very distinctly in a woodcut; but in his latter work, the same author represents the tabulæ as being horizontal, without explaining in the text the reason of this change.

2. FISTULIPORA MAJOR.

FISTULIPORA MAJOR, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d Series, vol. iii, p. 131, 1849.

— — *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 220, 1851.

"Cell-tubes two thirds of a line in diameter, and about their own diameter apart; their walls thick, of concentric layers, with closely placed funnel-shaped internal diaphragms; interstices minutely vesicular; four to six rows of vesicular cells between each pair of tubes.

"Rare in the Carboniferous Limestone of Derbyshire." (*M'Coy*, loc. cit.)

2. Genus PROPORA, (p. lix.)

1. PROPORA? CYCLOSTOMA.

HYDNOPHORA? CYCLOSTOMA, *Phillips*, Geol. of York., vol. ii, p. 202, pl. ii, figs. 9 & 10, 1836.

ASTREOPORA ANTICUA, *M'Coy*, Syn. of Carb. Foss. of Ireland, p. 191, pl. xxvi, fig. 9, 1844.

— — *M'Coy*, Ann. and Mag. of Nat. Hist., 2d Series, vol. iii, p. 133, 1849.

PROPORA? CYCLOSTOMA, *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 225, 1851.

"Discoid, convex; surface with large, circular cells, in quincunx, about one third their diameter apart; sides of the cells radiatingly striated; intervening flat spaces with minute, irregular, curving ridges." (*M'Coy*, 'Carb. Foss. of Ireland,' loc. cit.)

The fossil is known to us only by the figures and very brief descriptions given of it by Professor Phillips, and more recently, by Professor M'Coy. It appears to be very nearly allied to the Corals that form our genus *Propora*, and provisionally, at least, must be referred to that group. It is the only species of *Propora* that has, as yet, been found in the Carboniferous Deposits; all the others belong to the Silurian Formation.

Professor Phillips discovered this Coral in Northumberland, and Professor M'Coy mentions its existence in Ireland, at Hook Point, Wexford.

¹ Introduction, p. lix.

² *Milne Edwards and Jules Haime*, 'Polypiers Foss. des Terrains Palæozoïques,' p. 226.

Family FAVOSITIDÆ, (p. lx.)

Sub-Family FAVOSITINÆ, (p. lx.)

1. Genus FAVOSITES, (p. lx.)

1. FAVOSITES PARASITICA. Tab. XLV, fig. 2.

CALAMOPORA PARASITICA, *John Phillips*, Geol. of York., vol. ii, p. 201, pl. i, figs. 61 and 62, 1836.

FAVOSITES PARASITICA, *M'Coy*, Syn. Carb. Foss. of Ireland, p. 192, 1844.

— — *D'Orbigny*, Prod. de Palæont., vol. i, p. 160, 1850.

— — *Milne Edwards* and *J. Haime*, Pol. Foss. des Terr. Pal., p. 244, 1851.

Corallum forming small globular masses, and usually adhering to the stem of an Encrinite. *Walls* very thin. *Calices* unequal in size; some very small ones near the angles of the larger ones; the latter 1 or $1\frac{1}{2}$ line in diameter.

Fossil from the Carboniferous Limestone at Bolland, in Yorkshire; and according to Professor M'Coy, in Ireland.

The fossil designated by Colonel Portlock¹ and by Professor M'Coy,² under the name of *Favosites Gothlandica*, appears to belong to this species. The specimens mentioned by the first of these geologists were found in Tyrone and Derryloran; those described by the latter were met with in the Isle of Man, and in Derbyshire. A collector of the Museum of Paris, M. Marcou, found at Button Mould Knobs, near Louisville, in North America, a Coral, which we equally refer to the above-described species, although its calices are somewhat smaller.

The genus *Favosites*, which is so abundant in the fauna of the Silurian and Devonian Periods, appears to be represented only by the *F. parasitica* in the Carboniferous Formation; and the other fossils that various authors have described under this generic name, or as *Calamopora*, are now referred to different genera. We must, however, not omit mentioning here two Corals that are not sufficiently well known to be classed zoologically, although they probably are not true *Favosites*.

One of these fossils is the *Calamopora incrustans* of Professor Phillips.³ It was found in the Carboniferous Limestone at Bolland, and is known to us only by a very rough figure, given by that distinguished geologist.

The other is the *Calamopora dentifera* of the same author;⁴ it was met with at Bolland, but in the present state of Palæontological science cannot be characterised.

¹ Report on the Geology of Londonderry, &c., p. 326.

² Syn. Carb. Foss. of Ireland, p. 192.

³ Geology of Yorkshire, vol. ii, p. 200, tab. i, figs. 63, 64; *Favosites incrustans*, D'Orbigny, Prodr., vol. i, p. 160; Milne Edwards and Jules Haime, Polyp. Palæoz., p. 246.

⁴ Geology of Yorkshire, vol. ii, p. 201, tab. i, figs. 58, 60; *Favosites dentifera*, D'Orbigny, op. cit., p. 160; Milne Edwards and Jules Haime, loc. cit.

2. *Genus* MICHELINIA, (p. lx.)

1. MICHELINIA FAVOSA. Tab. XLIV, figs. 2, 2a, 2b, 2c.

HONEY COMB, *Parkinson*, Org. Rem. of a Former World, vol. ii, p. 39, pl. v, fig. 9, 1808.

MANON FAVOSUM, *Goldfuss*, Petref. Germ., vol. i, p. 4, tab. i, fig. 11, 1826.

PORITES CELLULOSA, *Fleming*, Brit. Anim., p. 511, 1828.

FAVASTREA MINON, *Blainville*, Dict. Sc. Nat., vol. lx, p. 340, 1830; *Man.*, p. 375.

PORITES CELLULOSA, *S. Woodward*, Syn. Table of Brit. Org. Remains, p. 6, 1830.

MICHELINIA FAVOSA, *De Koninck*, An. Foss. des Terr. Carb. de Belg., p. 30, pl. c, fig. 2, 1842.

COLUMNARIA SENILIS, *ib.*, p. 25, pl. B, fig. 9. Specimen in a bad state of preservation.

FAVOSITES ALVEOLATA, *Geinitz*, Grund. der Verst., p. 572, 1845-46.

MICHELINIA FAVOSA, *Michelin*, Icon. Zooph., p. 254, pl. lix, fig. 2, 1846.

MICHELINIA FAVOSA and FAVASTREA SENILIS, *D'Orbigny*, Prod., vol. i, p. 160, 1850.

MICHELINIA FAVOSA, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 249, 1851.

Corallum massive, generally circular; upper surface slightly convex; common basal plate covered with a thick epitheca, that sends off numerous and well-developed radiciform processes. *Calices* somewhat unequal, shallow, and presenting, in well-preserved specimens, margins thickened by small endothecal vesicles. When these vesicles are destroyed near the upper edge of the wall, thirty or forty somewhat unequal small septal striæ become visible, and the wall shows small horizontal series of pores. Diagonal of the calices three or four lines.

Found at Masbury, near Mendip, Somersetshire, and in Derbyshire; at Hook Point, Wexford, and in Enniskillen. The same species has been found at Tournay and Visé in Belgium, and at Ratingen, in Prussia; but it is erroneously that Goldfuss states that it is also met with in the Eifel. Specimens of this Coral are in the Collections of the Geological Society of London, of the Bristol Museum, of J. S. Bowerbank, Esq., &c.

Michelinia favosa differs from *M. antiqua* (see p. 156) and *M. concinna*¹ by the irregular form and vesicular structure of its endotheca. The aspect of its upper surface, due to the unequal development of the calices, distinguishes it from *M. geometrica*;² and the radiciform processes of its under surface distinguishes it from *M. convexa*,³ *M. tenuisepta*,⁴ and *M. megastoma*.⁵

¹ Lonsdale, in Geol. of Russia, by Murchison, Verneuil, and Keyserling, vol. ii, p. 611, pl. A, fig. 3.

² Milne Edwards and Jules Haime, Polyp. Palæoz., tab. xvii, fig. 15.

³ Op. cit., tab. xvi, fig. 1.

⁴ See tab. xlv, fig. 1.

⁵ See tab. xlv, fig. 3.

2. MICHELINIA TENUISEPTA. Tab. XLIV, figs. 1, 1a, 1b.

CALAMOPORA TENUISEPTA, *John Phillips*, *Illust. of Geol. of York.*, vol. ii, p. 201, pl. ii, fig. 30, 1836.

MICHELINIA TENUISEPTA, *De Koninck*, *An. Foss. des Terr. Carb. de Belg.*, p. 31, pl. c, fig. 3, 1842.

— — *Michelin*, *Icon. Zooph.*, pp. 83 and 254, pl. xvi, fig. 3, 1843.

FAVOSITES (MICHELINEA) TENUISEPTA, *M'Coy*, *Syn. Carb. Foss. of Ireland*, p. 193, 1844.

MICHELINEA GLOMERATA? *M'Coy*, *Ann. and Mag. of Nat. Hist.*, 2d Series, vol. iii, p. 122, 1849.

FAVOSITES TENUISEPTA and MICHELINIA TENUISEPTA, *D'Orbigny*, *Prod. de Palæont.*, vol. i, p. 160, 1850.

MICHELINIA TENUISEPTA, *Milne Edwards* and *Jules Haime*, *Pol. Foss. des Terr. Palæoz.*, p. 250, 1851.

MICHELINEA GLOMERATA? *M'Coy*, *Brit. Palæoz. Foss.*, p. 80, pl. iii B, fig. 14, 1851.

Corallum tall; common basal plate with a strong epitheca, striate transversely, but not bearing any radiciform processes. *Calices* polygonal, unequal in size, and containing thirty or forty equally developed septal striæ. *Tubulæ* very delicate, closely set, much blended together, and minutely granulated.

Height of the corallum 4 inches; diagonal of the calices 3 or 4 lines.

M. tenuisepta is found in the environs of Bristol, at Masbury, near Mendip, and at Bolland; Professor M'Coy has also met with it in Ireland; and it exists also on the Continent, at Sablé and Juigné, in France, and at Tournay, in Belgium. Specimens are in the collections of the Museums of Bristol, of Cambridge, of Paris, &c.

This species much resembles *M. favosa*, by the structure of the visceral chambers, but differs from it by the corallites being more elongate, and by the common basal plate not bearing any radiciform appendices. *M. tenuisepta* is also very closely allied to *M. convexa*¹ and *M. megastoma*,² but its endothecal vesicles are less convex, and it never attains the size to which this species usually come. The obliquity or irregular arrangement of its tabulæ distinguish it from *M. antiqua*³ and *M. concinna*,⁴ in which the tabulæ are almost horizontal and distinct. *M. geometrica*⁵ differs from the above-described species by the great regularity of its polygonal calices.

We refer to this species, but with some doubt, the fossil designated by Professor M'Coy, under the name of *Michelinea glomerata*; in the specimen figured by that geologist, the common basal plate is worn away, so that it is not possible to ascertain

¹ D'Orbigny, *Prod.*, vol. i, p. 107; Milne Edwards and J. Haime, *Polyp. Palæoz.*, tab. xvi, fig. 1.

² See tab. xlv, fig. 3.

³ *Dictyophyllia antiqua*, M'Coy, *Syn. of Carb. Foss. of Ireland*, tab. xxvi, fig. 10.

⁴ Lonsdale in *Geol. of Russia*, by Murch., Verneuil, and Keyserling, vol. i, p. 611, tab. A, fig. 3.

⁵ Milne Edwards and J. Haime, *Polyp. Palæoz.*, tab. xvii, fig. 3.

whether there are or not any radiceform appendices; the tabulæ appear, it is true, to be rather more convex than in the above-described species, but the data obtained, as yet, are not sufficient to enable us to characterise this Coral as forming a distinct species.

3. MICHELINIA MEGASTOMA. Tab. XLIV, figs. 3, 3a, 3b.

CALAMOPORA MEGASTOMA, *John Phillips*, *Illust. of Geol. of Yorkshire*, vol. ii, p. 201, pl. ii, fig. 29, 1836.

FAVOSITES MEGASTOMA, *M'Coy*, *Syn. Carb. Foss. of Ireland*, p. 192, 1844.

MICHELINIA GRANDIS, *M'Coy*, *Ann. and Mag. of Nat. Hist.*, 2d series, vol. iii, p. 123, 1840.

FAVOSITES MEGASTOMA, *D'Orbigny*, *Prod. de Paléont.*, vol. i, p. 160, 1850.

MICHELINIA MEGASTOMA, *Milne Edwards and Jules Haime*, *Polyp. Foss. des Terr. Palæoz.*, p. 251, 1851.

MICHELINIA GRANDIS, *M'Coy*, *Brit. Palæoz. Foss.*, p. 81, pl. iii c, fig. 1, 1851. Good figure.

Corallum subturbinate, convex, pediculate; common basal plate covered with a thick wrinkled epitheca, and not bearing any radiceform appendices. *Calices* very large, rather deep, and somewhat unequal in size. *Septal striæ* very delicate and numerous. *Tabulæ* entirely composed of vesicles, which are very convex, but always broader than high. Diagonal of the *calices* 8 or 9 lines.

This fossil has been found at Kendal and at Bolland, in England; in the Isle of Man; and at Attre, near Mons, in Belgium. Specimens are in the collections of the Geological Society of London, of the Bristol and Cambridge Museums, &c.

*M. geometrica*¹ is easily distinguished from this species by the regular hexagonal form of its calices; *M. antiqua*² and *M. concinna*³ differ from it by their large tabulæ, being almost horizontal; and *M. favosa*⁴ by the presence of radiceform processes. The above-described species differs from *M. convexa*⁵ and from *M. tenuisepta*⁶ by the large size of its corallites; and it appears to be intermediate between these two species by the form of the endothecal vesicles, these being less inflated than in *M. convexa*, and more convex than in *M. tenuisepta*.

4. MICHELINIA ANTIQUA.

DICTYOPHYLLIA ANTIQUA, *M'Coy*, *Syn. Carb. Foss. of Ireland*, p. 191, pl. xxvi, fig. 10, 1844.

MICHELINIA COMPRESSA, *Michelin*, *Icon. Zooph.*, p. 254, pl. lix, fig. 3, 1846.

— ANTIQUA, *D'Orbigny*, *Prod. de Paléont.*, vol. i, p. 160, 1850.

— — *Milne Edwards and Jules Haime*, *Pol. Foss. des Terr. Palæoz.*, p. 252, 1851.

¹ *Milne Edwards and Jules Haime*, *Pol. Foss. des Terr. Palæoz.*, pl. xvii, fig. 3.

² *Dictyophyllia antiqua*, *M'Coy*, *Syn. Carb. Foss. of Ireland*, pl. xxvi, fig. 10.

³ *Lonsdale in Murch.*, *Vern.*, *Keys.*, *Russ. and Ural*, vol. i, p. 611, pl. A, fig. 3.

⁴ See tab. xlv, fig. 2.

⁵ *D'Orbigny*, *Prodr.*, t. i, p. 107; *Milne Edwards and Jules Haime*, *loc. cit.*, pl. xvi, fig. 1.

⁶ Tab. xlv, fig. 1.

Corallum forming a thin incrustating expansion, its upper surface almost horizontal. *Calices* polygonal, very deep, rather unequal in size, and separated by slightly exsert ridges. *Septal striæ* 40 or 50 in number, almost equally developed, subvermiculate, and extending on the tabulæ to a small distance from the walls. *Tabulæ* closely set, almost horizontal towards the centre of the corallites, but very irregular towards their circumference. Diagonal of the calices from 5 to 8 lines.

Found at Hook-point, in Ireland, by Professor M'Coy; and at Tournay, in Belgium.

We have not been enabled to study any British specimens of this species; those that we have examined belonged to the carboniferous formation of Belgium; but the figure published by Professor M'Coy is sufficient to establish the specific identity between the Continental and the Irish fossil here alluded to; and we feel, consequently, no hesitation in inscribing *M. antiqua* in the list of British Corals.

In this species, as well as in *M. geometrica*¹ and in *M. concinna*², there are very numerous, almost horizontal, tabulæ; a structural peculiarity, which sufficiently distinguishes them from *M. favosa*,³ *M. tenuisepta*,⁴ *M. megastoma*,⁵ and *M. convexa*,⁶ in which the endotheca is entirely vesicular. *M. antiqua* differs from *M. geometrica* by the irregularity of its calices, the prolongation of the septal striæ on the upper surface of the tabulæ; the latter character, and its large size, also distinguishes it from *M. concinna*.

3. Genus ALVEOLITES, (p. lx.)

1. ALVEOLITES SEPTOSA. Tab. XLV, figs. 5, 5a, 5b.

FAVOSITES SEPTOSUS, *Fleming*, Brit. Anim., p. 529, 1828.

— — *S. Woodward*, Syn. Table of Brit. Org. Rem., p. 5, 1830.

— — *Phillips*, Geol. of Yorkshire, 2d part, p. 200, pl. ii, figs. 6, 7, 8, 1836.

— — *M'Coy*, Syn. Carb. Foss. of Ireland, p. 192, 1844.

CHÆTETES SEPTOSUS, *Keyserling*, Reise in Petschora, p. 183, 1846.

ALVEOLITES SEPTOSA, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 259, 1851.

CHÆTETES SEPTOSUS, *M'Coy*, Brit. Palæoz. Foss., p. 82, 1851.

Corallum forming an incrustating, slightly convex, or subgibbose mass, which is in general composed of superposed strata. *Calices* unequally developed, somewhat irregular in form, but in general polygonal and not having a prominent edge. *Walls* rather thin. The solitary septal process well characterised, and sometimes facing two small denticula. Breadth of the calices half a line or a little more.

¹ Milne Edwards and Jules Haime, Polyp. Palæoz., tab. xvii, fig. 3.

² Lonsdale, in Murch., Vern., and Keyser., Geology of Russia, vol. i, p. 611, pl. A, fig. 3.

³ See tab. xlv, fig. 2.

⁴ See tab. xlv, fig. 1.

⁵ See tab. xlv, fig. 3.

⁶ D'Orbigny, Prod., vol. i, p. 107; Milne Edwards and J. Haime, op. cit., p. 251, tab. xvi, fig. 1.

This coral is found at Corwen, near Bristol, and has also been met with at Lee, in Northumberland, by Mr. Phillips, in Westmoreland, in Derbyshire, and in Ireland, by Professor M'Coy, and at Novogorod, in Russia, by M. Keyserling. Specimens are in the Museum of Practical Geology, the Bristol Museum, &c.

The fossil mentioned by Colonel Portlock, under the name of *Favosites fibrosa*,¹ and found by that geologist at Armagh, Donaghenny, and Derryloran, in Ireland, appears to belong to this species.

2. ALVEOLITES DEPRESSA. Tab. XLV, figs. 4, 4a.

FAVOSITES DEPRESSUS, *Fleming*, Brit. Anim., p. 529, 1828.

— — *S. Woodward*, Syn. Table of Brit. Org. Rem., p. 5, 1830.

— CAPILLARIS, *John Phillips*, Geol. of Yorkshire, 2d part, p. 200, pl. ii, figs. 3, 4, 5, 1836.

— — *Portlock*, Rep. on Londonderry, p. 327, 1843.

— — *M'Coy*, Syn. Carb. Foss. of Ireland, p. 191, 1844.

CHÆTETES CAPILLARIS, *Keyserling*, Reise in Petschora, p. 183, 1846.

ALVEOLITES DEPRESSA, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 260, 1851.

CHÆTETES CAPILLARIS, *M'Coy*, Brit. Palæoz. Foss., p. 82, 1851.

Coral much resembling the preceding species, but having the calices much smaller and less irregular. Diameter of the corallites one tenth or one eighth of a line.

The specimens here described were found near Bristol, and in Salop, and were communicated to us by the directors of the Bristol Museum and Museum of Practical Geology. The existence of the same fossil is mentioned by Mr. Phillips, at Gordale and Ribblehead, by Professor M'Coy, at Kendal, Westmoreland, by Col. Portlock, at Armagh, and by M. Keyserling, in Petschora.

Sub-Family CHÆTETINÆ, (p. lxi.)

1. Genus CHÆTETES, (p. lxi.)

1. CHÆTETES RADIANS.

CHÆTETES RADIANS, *Fischer*, Oryct. de Moscou., p. 160, pl. xxxvi, fig. 3, 1830.

— DILATATUS, CYLINDRICUS, and JUBATUS, *Fischer*, pp. 160, 161, pl. xxxvi, figs. 1, 2, 4, 1830.

FAVOSITES EXCENTRICA, *Fischer*, pl. xxxv, figs. 5, 6.

CHÆTETES EXCENTRICUS, *Fischer*, Oryct. de Moscou., 2d edit. p. 159, pl. xxxv, figs. 5, 6, 1837.

— RADIANS, *Lonsdale*, in Russ. and Ural, vol. i, p. 595, pl. A, fig. 9, 1845.

— DILATATUS, *Lonsdale*, p. 596.

— RADIANS, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 263, pl. xx, fig. 4, 1851.

¹ Report on Londonderry, p. 327.

Corallum constituting a tall pyriform mass, the upper surface of which is very convex, with polygonal calices and simple well-developed walls. The *calices* are somewhat unequal in size and in form, being sometimes rather triangular, tetragonal, or hexagonal. The *corallites* are very long, and radiate from the basis of the corallum to the top. The *walls* are not perforated. *Tabulæ* horizontal, and placed at about one sixth of a line distance.

This fossil has been met with at Hilsington Barrow, near Kendal, and in various localities in Russia. The only British specimen which we have seen belongs to the Museum of the Geological Society of London, and is not in a state of preservation sufficiently good to render it worth being figured in this Monograph.

C. radians differs from most of the other species belonging to the same genus by its massive, convex form, and apparently also by the absence of mamillæ on its surface. The same characters are met with only in *C. crinitus*¹ and *C. Trigeri*,² but the first of these corals differs from the species above described by the existence of superposed layers, and the second by its large calices and slender walls.

2. CHÆTETES TUMIDUS. Tab. XLV, figs. 3, 3a, 3b.

CALAMOPORA TUMIDA, *Phillips*, Geol. of Yorkshire, 2d part, p. 200, pl. i, figs. 49—57, 1836.

FAVOSITES SCABRA, or CALAMOPORA FIBROSA, *De Koninck*, An. Foss. des Terr. Carb. de Belgique, p. 9, pl. B, figs. 1, 5, 1842.
Worn specimen.

CALAMOPORA INFLATA, *ibid.*, p. 10, pl. A, fig. 8.

ALVEOLITES IRREGULARIS, *ibid.*, p. 11, pl. B, fig. 2.

FAVOSITES TUMIDA, *Portlock*, Rep. Geol. on Londonderry, p. 326, pl. xxii, fig. 4, 1843.

— *M'Coy*, Syn. Carb. Foss. of Ireland, p. 193, 1844.

ALVEOLITES TUMIDA, SCABRA and IRREGULARIS, *Michelin*, Icon. Zooph., p. 259, 260, pl. lx, figs. 2, 3, 4, 1846.

FAVOSITES INFLATA, *M'Coy*, Ann. and Mag. of Hist., 2d Ser., vol. iii, p. 134, 1849.

FAVOSITES TUMIDA, CHÆTETES KONINCKII, CERIOPORA IRREGULARIS, TUMIDA and INFLATA, *D'Orbigny*, Prodr. de Pal., Vol. i, p. 160, 161, 1850.

CHÆTETES TUMIDUS, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 270, 1851.

STENOPORA INFLATA and TUMIDA, *M'Coy*, Brit. Palæoz. Fos., p. 82, 1851.

Corallum forming cylindrical branches of various sizes. *Calices* unequally developed, with rather thick margins. In general eight calices occupy the space of about one line, but on the slightly projecting gibbosities of the surface of the corallum the calices are somewhat larger, and almost circular.

This fossil has been found at Harrowgate, Greenhow Hill, Brough, Kirby Lonsdale ;

¹ *Stenopora crinita*, Lonsdale, in Strzelecki, New South Wales and Van Dieman's Island, tab. viii, fig. 5.

² *Milne Edwards* and *Jules Haime*, Polyp. Palæoz., p. 269, tab. xvii, fig. 6.

Middleham, Florence Court, and Arran, by Professor Phillips; in Derbyshire, at Kendal, in the Isle of Man, at Kulkrag in Fermanagh, at Clogher and Benburn, (Tyrone,) by Colonel Portlock, and in Belgium. A specimen, in a very bad state of preservation, that belongs to the collection of the Geological Society, was met with in the Llandeilo Flags in Marloes Bay, and appears to be specifically identical with the above-described carboniferous fossils.

C. tumidus can easily be distinguished from the other species of the same genus which have a similar form, by the very small size of their calices, their thick margin, and almost circular form.

We are inclined to think that the fossil described by Professor M'Coy, under the name of *Verticillopora dubia*,¹ may belong to this species. The *Ramose milleporite* of Parkinson,² appears also to be referable to it. This last-mentioned fossil was found in Wiltshire.

2. Genus BEAUMONTIA.³

1. BEAUMONTIA EGERTONI. Tab. XLV, fig. 1.

BEAUMONTIA EGERTONI, *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 276, 1851.

Corallum forming a tall, lobate mass. *Corallites* basaltiform, somewhat flexuous, and showing distinctly costal striæ under the epitheca. *Calices* very variable in size; the largest about three lines in diameter. *Tabulæ* closely set, mostly horizontal, and very slightly convex, some incomplete and subvesicular.

The specimen here described belongs to the collection of the Geological Society of London, and was found by Sir P. Egerton, at Sracrapagh, Fermanagh (Ireland).

The genus *Beaumontia* has been established by us since the publication of the first part of this Monograph; it is, therefore, necessary to mention here that it comprises the Favositidæ with non-perforated walls and a more or less vesicular endotheca. This division has the same relation to *Chætetes* as *Michelinia* has to Favosites.

Beaumontia Egertoni differs from *B. venelorum*⁴ and *B. laxa*, by its tabulæ being mostly horizontal, and but very slightly convex. In a fourth species, *E. Guerangeri*,⁵ the calices are much more irregular, and smaller.

¹ Synop. of Carboniferous Fossils of Ireland, p. 194, tab. xxvii, fig. 12; *Ceriopora dubia*, D'Orbigny, Prod., vol. i, p. 161.

² Organ. Rem., vol. ii, tab. viii, fig. 3; *Millepora ramosa*, Woodward, Synop. Table of Brit. Org. Rem., p. 5.

³ Milne Edwards and Jules Haime, Pol. Foss. des Terr., Palæoz., p. 276, 1851.

⁴ Op. cit., p. 276, tab. xvi, fig. 6.

⁵ Op. cit., tab. xvii, fig. 1.

2. BEAUMONTIA LAXA.

COLUMNARPA LAXA, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d Series, vol. iii, p. 122, 1849.

BEAUMONTIA LAXA, *Milne Edwards* and *J. Haime*, Pol. Foss. des Terr. Palæoz., p. 277, 1851.

COLUMNARIA LAXA, *M'Coy*, Brit. Palæoz. Foss., p. 92, pl. iii c, fig. 11, 1851.

Corallites very long, sometimes free laterally, and cylindrical; at other times, aggregate and prismatical, or presenting some intermediate state between these two forms. *Epitheca* strong, complete, and not showing any traces of the costal striæ in the free state. In the aggregate prismatic corallites, the transverse wrinkles of the epitheca become thinner, and the straight, rather closely set costal striæ are then very visible. The visceral cavity or interior of the corallites is completely filled up with very large, irregular vesicles, that are convex upwards, decline outwardly, and never form complete tabulæ.

Height, nearly 8 inches; diameter of the corallites 4 lines.

Found at Wellington, and in Derbyshire. Specimens are in the collections of the Cambridge Museum, and of M. E. de Verneuil, at Paris.

This Coral differs from the other species of *Beaumontia*, by the tendency of the corallites to remain separate, or to coalesce but incompletely. By the entirely vesicular structure of its endotheca, it approximates to *B. venelorum*,¹ in which species the corallites are always basaltiform, and vary much in breadth.

Sub-Family HALYSITINÆ, (p. lxi.)

Genus SYRINGOPORA, (p. lxii.)

1. SYRINGOPORA RAMULOSA. Tab. XLVI, figs. 3, 3a, 3b, 3c.

TUBIPORA, *Knorr* and *Walch*, Rec. des Mon. des Catastr., vol. iii, p. 168, Supp., pl. 6 F, fig. 1, 1775.

SYRINGOPORA RAMULOSA, *Goldfuss*, Petref. Germ., vol. i, p. 76, pl. xxv, fig. 7, 1826.

— — *Morren*, Descr. Corall. in Belg. rept., p. 69, 1832.

— — *John Phillips*, Geol. of York, vol. ii, p. 201, pl. ii, fig. 2, 1836.

— — *Milne Edwards*, Ann. de la 2e Edit. de Lamarck, vol. ii, p. 327, 1836.

— — *Portlock*, Rep. on Londonderry, p. 337, 1843.

— — *M'Coy*, Syn. Carb. Foss. of Ireland, p. 190, 1844.

HARMODITES RAMULOSUS, *Keyserling*, Reise in Petschora, p. 174, 1846.

— — *D'Orbigny*, Prod. de Palæont., vol. i, p. 162, 1850.

SYRINGOPORA RAMULOSA, *Milne Edwards* and *J. Haime*, Pol. Foss. des Terr. Palæoz., p. 289, 1851.

— — *M'Coy*, Brit. Palæoz. Foss., p. 83, 1851.

¹ *Milne Edwards* and *Jules Haime*, op. cit., tab. xvi, fig. 6.

Corallites elongated, flexuous, rather widely separated from each other, and subgeniculated at the origin of the connecting tubes. *Epitheca* delicately wrinkled transversely. Connecting tubes placed at the distance of about 3 lines; diameter of the corallites $1\frac{1}{4}$ or $1\frac{1}{2}$ lines.

The British specimens which we have had an opportunity of examining were found by the officers of the Geological Survey at Oswestry, Mold, and Bradwell. Professor Phillips has found the same species at Bolland, Kirby Lonsdale, Ash-Fell, and Mendip; Professor M'Coy mentions its existence in the Carboniferous Formation of the Isle of Man; and Col. Portlock has met with it at Kilcronaghan, Derry, and at Clogher, Tyrone. This fossil is also found on the Continent, at Visé and Tournay, in Belgium; Olne, in Limburg; Ratingen, in Prussia, and Utkinsk, in Russia.

Syringopora ramulosa is remarkable on account of the distance between the corallites and their geniculate forms, peculiarities which distinguish it from *S. geniculata*,¹ a species much less deserving the specific appellation given to it.

2. SYRINGOPORA RETICULATA. Tab. XLVI, figs. 1, 1a.

- TUBIPORA STRUES, AFFINIS, &c., *Parkinson*, Org. Rem., vol. ii, pl. ii, fig. 1, 1808.
 ERISMATOLITHUS TUBIPORITES (CATENATUS) (pars), *William Martin*, Petref. Derb., pl. xlii, fig. 2, 1809, but not fig. 1.
 SYRINGOPORA RETICULATA, *Goldfuss*, Petref., vol. i, p. 76, tab. xxv, fig. 8, 1826.
 TUBIPORA STRUES, *Fleming*, Brit. An., p. 529, 1828.
 — — *S. Woodward*, Syn. Table of Brit. Org. Rem., p. 5, 1830.
 HARMODITES RADIAN, *Bronn*, Leth. Geogn., vol. i, p. 51, tab. v, fig. 7, 1835.
 SYRINGOPORA RETICULATA, *John Phillips*, Geol. of York, vol. ii, p. 201, 1836.
 — — *Milne Edwards*, Ann. de la 2e Edit. de Lamarek, vol. ii, p. 328, 1836.
 — — *Portlock*, Rep. on Lond., p. 337, pl. xxii, fig. 7, 1843.
 — CATENATA, *M'Coy*, Syn. Carb. Foss. of Ireland, p. 189, 1844.
 HARMODITES STRUES, *D'Orbigny*, Prod. de Palæont., vol. i, p. 162, 1850.
 SYRINGOPORA RETICULATA, *Milne Edwards* and *J. Haime*, Pol. Foss. des Terr. Palæoz., p. 290, 1851.
 — — *M'Coy*, Brit. Palæoz. Foss., p. 84, 1851.

Corallites very long, diverging slightly, separated by a space equal to once or twice their diameter, and straight or slightly flexuous. Connecting tubes thick, somewhat irregularly arranged, and placed $1\frac{1}{2}$ or 2 lines apart.

Diameter of the corallites 1 line or less.

This fossil has been found in the Carboniferous Deposits of Bristol, Lilleshall; Winster, Buxton (Martin); Ashfell, Derbyshire (Professor Phillips); Kendal, Westmoreland,

¹ *Milne Edwards* and *Jules Haime*, Polyp. Foss. des Terr. Palæoz., tab. xx, fig. 1; *Harmodites catenatus*, *De Koninck*, Anim. Foss. des Terr. Carbonif. de la Belgique, tab. B, fig. 4.

the Isle of Man (Professor M'Coy); and Clogher and West Longfield, Tyrone (Colonel Portlock). It is also met with at Olne in the province of Limbourg.

Syringopora reticulata is remarkable for the small number of its connecting tubes, and for the existence of a delicate transverse lamina which passes through the concentric infundibula, and is shown by a transverse section of the corallum, (tab. xlvi, fig. 1a.)

3. SYRINGOPORA GENICULATA. Tab. XLVI, figs. 2, 2a, and fig. 4.

TUBIPORA MUSICA, AFFINIS, *Parkinson*, Org. Rem., vol. ii, pl. i, figs. 1, 2, 1808.

— CATENATA, *Fleming*, Brit. Anim., p. 529, 1828. (Not Martin.)

— RAMULOSA, *S. Woodward*, Syn. Table of Brit. Org. Rem., p. 5, 1830. (Not *Syring. ramulosa*, Goldfuss.)

SYRINGOPORA GENICULATA, *John Phillips*, Geol. of Yorkshire, vol. ii, p. 201, pl. ii, fig. 1, 1836.

— — *Portlock*, Rep. on Londonderry, p. 337, pl. xxii, fig. 6, 1843.

— — *M'Coy*, Syn. Carb. Foss. of Ireland, p. 190, 1844.

— — *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 291, 1851.

— — *M'Coy*, Brit. Palæoz. Foss., p. 83, 1851.

HARMODITES GENICULATA, *D'Orbigny*, Prodr. de Pal., vol. i, p. 162, 1850.

Corallites very long, diverging slightly towards their upper extremity, cylindrical, very closely set, and surrounded with a thick, wrinkled epitheca. Connecting tubes numerous, not appearing to have any regular mode of arrangement, placed at one line or one line and a half apart, and in general very short, in consequence of an agglomeration of the corallites. A horizontal section of a specimen transformed into a mass of marble, shows very distinctly that the connecting tubes are hollow, and establish a free communication between the visceral chambers of the connected corallites. *Walls* rather thick. *Septa* in general fourteen in number, thin, equally developed, straight, not extending much towards the centre of the visceral chamber, and not closely set. Length of the corallites in general from 5 to 8 inches. Diameter about 1 line or somewhat less; distance between these usually half a line.

This fossil has been found by the collectors of the geological survey at Kendal, Westmoreland, and Professor Phillips mentions its having been met with at Ashfell and at Mendip. Some young corals found at Oswestry, (Tab. XLVI, fig. 4), and differing from the above-described specimens by the diameter of the corallites being smaller, appear to belong to this species, which, according to Colonel Portlock, is also met with in Ireland, at Derryloran, Erigal-Keerogue (Tyrone), and Crevinish, near Kesh (Fermanagh). Specimens are in the collections of Messrs. Phillips, Stokes, Bowerbank, &c.

Syringopora geniculata is easily recognisable by the very slight geniculation of its very closely set corallites and its numerous connecting tubes.

4. SYRINGOPORA CATENATA.

ERISMATOLITHUS (TUBIPORITES) CATENATUS, *Martin*, Petref. Derby., pl. xlii, fig. 1, 1809.

(Not the fig. 2 which belongs to the
S. reticulata.)

SYRINGOPORA CATENATA, *M'Coy*, Brit. Palæoz. Foss., p. 83, 1851.

“*Corallum* forming large masses of nearly equal, sub-parallel, very slightly diverging tubes, averaging half a line in diameter, and about their diameter apart, connected by nearly equal, transverse tubuli, slightly more than the diameter of the tubes apart, the origin of each producing a slight angular flexuosity in the main tubes; tubular central opening rather large. Found in the carboniferous limestone of Derbyshire.” (*M'Coy*, op. cit.)

We have not had an opportunity of examining this fossil, but it appears to be very closely allied to a species found in the Silurian formation, the *Syringopora fascicularis*, or *Tubipora fascicularis* of Linnæus,¹ and seems to differ from it only by the corallites being rather more regular and more closely set.

SYRINGOPORA LAXA, of Professor Phillips,² is as yet but very imperfectly known; it is described as having its corallites irregularly coalescent and distant, with very few connecting tubes. It was found by that geologist at Ash Fell, Derbyshire, and is mentioned by Colonel Portlock³ as having been met with at Enniskillen.

The fossils described by Professor M'Coy, under the names of *Aulopora campanulata*,⁴ *Aulopora gigas*,⁵ *Jania bacillaria*,⁶ and *Cladochonus brevicollis*,⁷ are evidently young syringoporæ. We are inclined to think that *Cladochonus tenuicollis* of the same author⁸ may equally belong to this genus, but we entertain more doubt respecting the natural affinities of the fossils which that geologist first described under the names of *Jania antiqua*⁹ and *Jania crassa*,¹⁰ and has more recently referred to the genus *Cladochonus*.¹¹

¹ See our Monographie des Polyp. des Terrains Palæozoïques, p. 293.

² Geol. of Yorkshire, p. 201.

³ Report on Londonderry, &c., p. 338.

⁴ Synop. Carb. Foss. of Ireland, p. 190, tab. xxvi, fig. 15.

⁵ Op. cit., tab. xxvii, fig. 14.

⁷ Ann. and Mag. of Nat. Hist., 2d Series, vol. iii, p. 128.

⁹ Carbonif. Foss. of Ireland, p. 197, tab. xxvi, fig. 12.

¹¹ Ann. and Mag. of Nat. Hist., 2d Series, vol. iii, p. 134.

⁶ Op. cit., p. 197, tab. xxvi, fig. 11.

⁸ Ibid., vol. xx, p. 227, tab. xi, fig. 8.

¹⁰ Op. cit., tab. xxvii, fig. 4.

Family SERIATOPORIDÆ, (p. lxiii.)

Genus RHABDOPORA, (p. lxiii.)

RHABDOPORA MEGASTOMA.

DENDROPORA MEGASTOMA, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d Series, vol. iii, p. 129. 1849; Brit. Palæoz. Foss., p. 79, pl. iii B, fig. 11, 1851.

RHABDOPORA MEGASTOMA, *Milne Edwards* and *Jules Haime*, Brit. Foss. Corals, Introd., p. lxiii, 1850; Pol. Foss. des Terr. Palæoz., p. 305, 1851.

Corallum subarborescent; its branches coming off at an angle of about 70°; sub-quadrangular, and differing but little in size. Surface of the cœenchyma granulated, or subechinulated, and obscurely striated. *Calices* arranged in a single row on each surface of the branches, distant from each other, somewhat oval longitudinally, and having slightly prominent edges. Twelve septal tubercles, somewhat unequal in size, and rather thick. Diameter of the branches a little more than half a line; long diameter of the calices about the same.

Found in the carboniferous limestone in Derbyshire, (Cambridge Museum.)

This coral is the only species belonging to the family of *Seriatoporidæ* that has as yet been discovered in the carboniferous formation. It was referred, by Professor M'Coy, to the genus *Dendropora* of M. Michelin, but we have considered it as constituting the type of a peculiar generical division that differs from the former by the septa being more developed and slightly exsert, by the tetragonal form of its branches, the mode of arrangement of its calices, and the structure of the cœenchyma, which is echinulate, slightly striated, and not very compact, whereas in *Dendropora* it is quite compact, and its surface completely smooth. Professor M'Coy, who appears to have taken only this last-mentioned character into consideration, does not adopt a generical distinction between *Dendropora* and *Rhabdopora*, because he argues that M. Michelin having overlooked the existence of septa in *Dendropora*, may also not have noticed the granulations of the cœenchyma. But we must beg leave to remark that the observations of M. Michelin are quite foreign to the motives which induced us to establish our genus *Rhabdopora*; it is never from a description, or a simple inspection of a drawing, that we feel authorised to propose new divisions of that value, but it is from an attentive examination of the fossils themselves that we have formed our opinion, and we are fully persuaded that if Professor M'Coy had been enabled to study, as we have done, both the corals described by himself and that figured by M. Michelin, he would have adopted the conclusions we have ourselves come to, and have considered them as appertaining to two perfectly distinct genera.

Family AULOPORIDÆ.¹Genus PYRGIA.²

PYRGIA LABECHII. Tab. XLVI, figs. 5, 5a.

PYRGIA LABECHII, *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Pal., p. 311, 1851.

Corallum simple, subturbinate, scarcely bent, and sub-pedicellate. *Epitheca* thick, and wrinkled transversely. *Calice* circular and very deep; 30 or 40 septal striæ. Height 5 lines; diameter of the calice $2\frac{1}{2}$ lines.

Found at Frome. Specimens are in the Museum of Practical Geology, &c.

The genus *Pyrgia* is composed of corals which may be considered as being simple and free Aulopora.

It comprises two species; the above-described fossil and *P. Michelini*,³ which differs from the first by the existence of a long horizontal peduncle and one or two small spur-like radiciform processes.

Family CYATHAXONIDÆ, (p. lxxv.)

Genus CYATHAXONIA, (p. lxxv.)

CYATHAXONIA CORNU.

STYLINA SIMPLE, *Parkinson*, Introd. to the Study of Foss. Org. Rem., pl. x, fig. 4, 1822.

Good figure.

CYATHOPHYLLUM MITRATUM (pars), *De Koninck*, Anim. Foss. des Terr. Carb. de Belg., p. 22, pl. c, figs. 5e, 5f, 1842. (Cæt. excl.)

Not Goldfuss.

CYATHAXONIA CORNU, *Michelin*, Icon. Zooph., p. 258, pl. lix, fig. 9, 1846.

— — *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 320, pl. i, fig. 3, 1851.

— — *M'Coy*, Brit. Palæoz. Foss., p. 109, 1851.

— MITRATA, *D'Orbigny*, Prod. de Pal., vol. i, p. 158, 1850.

Corallum cylindro-conical, bent in the form of a horn, pointed at the basis, and surrounded with a thin epitheca which has some slight circular wrinkles, but is never echinulated. *Calice* circular, rather deep, and with thin margins. *Columella* cylindrico-conical, very prominent, slightly compressed, and compact, but having a small central canal. *Septal fossula* narrow, but well defined. *Septa* very thin, narrow at their upper

¹ *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Pal., p. 310, 1851.

² Op. cit., p. 310.

³ Ibid., Polyp. Palæoz., p. 310, tab. xvii, fig. 8.

end and forming four cycla; those of the first three cycla nearly equal, alternating with an equal number of smaller ones, and extending in general to the columella, where they present a small obtuse lobe; the tertiary ones are inclined towards those of the second cyclum, and become united to them near the centre of the visceral chamber. Height of the coral from 5 to 8 lines; diameter of the calice 2 lines. A vertical section shows that the interseptal loculi are quite open.

This fossil has been found at Kendal and at Tournay. A very ill-preserved coral, met with in some part of Yorkshire, also appears to belong to this species. Professor M'Coy mentions its existence in Derbyshire. The only well-preserved British specimens that we have seen belong to the collections of the Cambridge Museum; specimens from Belgium are common in the palæontological collections in Paris.

In our Monograph of the Corals from the Palæozoic Formations we have described five other species of *Cyathaxonia*, which can all be easily distinguished from *C. cornu*: *C. Konincki*¹ by being fixed; *C. cynodon*² by its walls being armed with rows of spines; *C. tortuosa*³ and *C. profunda*⁴ by their septa being more numerous, and by their greater size; and *C. Dalmani*⁵ by its thick form and its strongly compressed subcristiform columella.

Family CYATHOPHYLLIDÆ, (p. lxxv.)

Sub-Family ZAPHRENTINÆ, (p. lxxv.)

1. Genus ZAPHRENTIS, (p. lxxv.)

1. ZAPHRENTIS CORNUCOPIÆ.

CANINIA CORNUCOPIÆ, *Michelin*, Icon. Zooph., p. 256, pl. lix, fig. 5, 1846. Very bad figure.

ZAPHRENTIS CORNUCOPIÆ, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 331. pl. v, fig. 4, 1851.

CYATHOPSIS CORNUCOPIÆ ? *M'Coy*, Brit. Palæoz. Foss., p. 90, 1851.

Corallum conical, elongated, curved, delicately pedunculated and bearing very slight circular wrinkles. *Calice* oval and deep. *Septal fossula* centro-dorsal, elongated. *Septa* numerous; thirty-two large ones alternating with an equal number of thinner but well-developed ones; the former are rather thick at their upper end, but very narrow, and extend to the edge of the septal fossula, on the side of which they are slightly curved, and become united together. Height of the coral one inch, or somewhat more; great diameter of the calice at least 5 lines; its depth 4 or 5 lines.

¹ *Milne Edwards* and *Jules Haime*, Polyp. Palæoz., p. 321.

² Op. cit., tab. i, fig. 4.

³ *Michelin*, Iconogr., tab. lix, fig. 8.

⁴ *Milne Edwards* and *Jules Haime*, op. cit., p. 323.

⁵ *Milne Edwards* and *Jules Haime*, op. cit., tab. i, fig. 6.

Professor M'Coy mentioned the existence of this species at Red Castle, Maset Rath, Glasgow, the Isle of Man, and Kendal. Specimens from Tournay are in the Paris Museum, and in the collections of M. de Verneuil and M. Michelin. It is from the latter that we have described this fossil, and it is only on the authority of Professor M'Coy that we enter it here in the list of the British Corals.

Z. cornucopiæ is easily distinguished from most species belonging to the same genus by the position and the form of the septal fossula, which extends from the centre of the calice to a small distance from the mural margin towards the large curve or dorsal side of the corallum. This species is, however, very nearly allied to *Z. Konincki*,¹ from which it differs principally by its calice being circular and its septa thicker and broader. In *Z. centralis*² the septal fossula is also placed in the centre of the calice, but does not extend outwards, and the septa are strong, and seem inclined to form four groups. *Z. Griffithi*³ is much stouter, and its calice presents two small lateral septal fossulæ. In *Z. Enniskilleni*⁴ the septal fossula extends from the centre of the visceral chamber towards the concave side or small curve of the wall. In *Z. Bowerbanki*⁵ the fossula remains limited to the centre of the calice, and in *Z. Phillipsi*⁶ it is almost central and circular.

2. ZAPHRENTIS PHILLIPSI. Tab. XXXIV, figs. 2, 2a, 2b.

ZAPHRENTIS PHILLIPSI, *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 332, pl. v, fig. 1, 1851.

Corallum slightly curved, somewhat elongate, and encircled with a few well-marked constrictions, sometimes presenting even a series of solutions of continuity in its wall. *Epitheca* strong. *Calice* circular, very deep, and having a thin margin. *Septal fossula* large, situated towards the dorsal side or large curve of the corallum, but near the centre of the calice, deep, enlarged outwardly, and presenting in its middle a septum that is very distinct from the other ones. In the adult specimens thirty-two principal *septa* thin, very narrow, extending to the edge of the fossula, alternating with an equal number of small ones, and forming four groups in consequence of the three primary ones being slightly prominent, and representing, with the fossula, a four-branched cross; in each of the two of these divisions situated on the dorsal side of the calice there are seven principal *septa*, and in the two others eight; the first of these *septa* somewhat deviating from the regular radial arrangement. Height of the corallum about 14 lines; diameter and depth of the calice 7 or 8 lines.

Found at Frome, and Slab-house, in England; at Tournay, in Belgium; and at Sablé, in France.

¹ Milne Edwards and Jules Haime, Polyp. Palæoz., tab. v, fig. 5.

² See tab. xxxiv, fig. 3.

⁶ See tab. xxxiv, fig. 2.

⁴ See tab. xxxiv, fig. 1.

² Ibid., tab. iii, fig. 6.

⁵ See tab. xxxiv, fig. 4.

The British specimens of this species that we have seen in the Museum of Bristol and of Practical Geology, were all younger than some of our Belgian specimens, and that circumstance accounts for their not having so many septa, (twenty-six instead of thirty-two,) their calice was also more or less broken down, the upper tabula appeared also more extensive than in the well-preserved adult individuals; but not having discovered any important difference between all these fossils we are confident in their specific identity.

As the position and the form of the septal fossula appear to furnish very good characters for the different species of this genus, *Z. Phillipsi* may at first sight be distinguished from all the species in which that fossula is placed on the ventral or inverted side of the corallum, and from those in which the fossula, although placed, as in this, on the dorsal side, is quite near to the wall of the calice, and extends but little towards the centre of the visceral chamber. The species in which the fossula so far resembles that of *Z. Phillipsi* differ from it by the following peculiarities: in *Z. cornucopiæ*¹ the fossula is long and narrow; in *Z. Konincki*² the septa are thicker towards their upper end and have a prominent lobe at their inner edge; in *Z. Griffithi*³ there are two small septal fossulæ, and in *Z. Michelini*⁴ the general form of the corallum is less elongate and less regular, and the septa are stronger and more equal in size.

3. ZAPHRENTIS GRIFFITHI. Tab. XXXIV, figs. 3, 3a.

ZAPHRENTIS GRIFFITHI, *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 333, 1851.

Corallum short, turbinate, and slightly curved. *Epitheca* thin, and forming small circular ridges. *Calice* circular, not very deep, and having a thin edge. *Septal fossula* large, deep, extending to the centre of the calice, and placed on the dorsal side of the corallum, (that is to say, towards the convex curve.) Some appearance of two other small septal fossulæ placed at right angles with the former one. Thirty-six principal septa, somewhat unequally developed alternately, not closely set, and uniting two by two at their inner edge, where they are slightly bent; those situated near the fossula are somewhat deviated from the normal radiate direction, and unite at their inner edge so as to constitute the lateral margins of the fossula; an equal number of small septa alternating with those above described. *Tabulæ* well developed. Height of the corallum 12 or 13 lines; diameter of the calice somewhat more.

The only specimen that we have seen belongs to the collection of Mr. Stokes, and was found at Clifton.

This species differs from all the other known Zaphrentes in having its septal fossula centro-dorsal, two small lateral fossulæ, and a short and broad form.

¹ *Caninia cornucopiæ*, Michelin, Icon., tab. lix, fig. 5; Milne Edwards and Jules Haime, Polyp. Palæoz., tab. v, fig. 4.

² Milne Edwards and Jules Haime, op. cit., tab. v, fig. 5.

³ See tab. xxxiv, fig. 3.

⁴ Ibid., op. cit., tab. iii, fig. 8.

4. ZAPHRENTIS ENNISKILLIENI. Tab. XXXIV, fig. 1.

ZAPHRENTIS ENNISKILLIENI, *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 334, 1851.

Corallum conical, slightly curved, pointed at its under end, covered with a thin epitheca, and not showing any circular accretion swellings. *Calice* circular, very deep, and terminated by a thin margin. *Septal fossula* well marked, situated towards the concave or ventral side of the corallum, and not reaching quite to the centre of the visceral chamber. Principal *septa* numerous (about forty), very thin, extremely narrow upwards, and straight or but very slightly curved inwards; two of them somewhat larger than the others, and forming an angle at the end of the septal fossula. An equal number of small septa alternating with the principal ones. Height of the corallum 3 inches; depth of the calice more than half that length; diameter of the calice $1\frac{1}{2}$ inch.

The only specimen that we have seen was presented to the Geological Society by Lord Enniskillen, and had been found by that Palæontologist at Loughgill, in the county of Sligo.

This species may easily be distinguished from all the other known Zaphrentis by the great depth of its calice and the position of the septal fossula.

5. ZAPHRENTIS BOWERBANKI. Tab. XXXIV, figs. 4, 4a.

ZAPHRENTIS BOWERBANKI, *Milne Edwards and Jules Haime*, Polyp. Foss. des Terr. Palæoz., p. 338, 1851.

Corallum very long, almost cylindrical, strongly curved, terminated by a narrow peduncle, covered with a strong epitheca, and presenting well-marked circular constrictions, and accretion swellings. *Calice* circular. *Septal fossula* very small, almost central, situated towards the ventral or concave side of the corallum, and divided at its basis by the principal septum, which extends to some distance in its cavity. Principal *septa* not numerous (24), very thin, somewhat unequal, and extending almost to the centre of the calice; rudimentary *septa* alternating with the principal ones. Height of the corallum 2 or 3 inches; diameter of the calice, 6 lines.

Found at Oswestry, at Frome, and in Ireland. Specimens are in the Collections of the Museum of Practical Geology, of the Geological Society, of Mr. Bowerbank, and of the Paris Museum.

This species is remarkable for the smallness of its well circumscribed, sub-central fossula, and by the way in which one of the primary *septa* extends into its cavity. By the great development of this septum *Z. Bowerbanki* approximates somewhat to the genus *Hallia*,¹ but, in the latter, the *septal fossula* does not exist.

¹ See Introduction, page lxvii.

6. ZAPHRENTIS PATULA.

CANINIA PATULA, *Michelin*, Icon. Zooph., p. 255, pl. lix, fig. 4, 1846.

ZAPHRENTIS PATULA, *Milne Edwards* and *Jules Haime*, Polyp. Foss. des Terr. Palæoz., p. 338, 1851.

CYATHOPSIS FUNGITES, *M'Coy*, Brit. Palæoz. Foss., p. 91, 1851. (Not *Turbinolia fungites*, Fleming.)

Corallum conical, somewhat elongate, strongly curved, delicately pedunculated, and showing well-marked circular accretion swellings. *Calice* large and deep. *Septal fossula* deep, broad, not extending to the centre of the calice, and situated towards the dorsal or convex side of the corallum. Principal *septa* numerous (about 40), equally developed, very thin, and extending on the tabula, in the form of slightly curved ridges. Height of the *corallum* $2\frac{1}{2}$ or 3 inches, diameter of the *calice* almost 2, depth 8 lines.

It is on the authority of Prof. M'Coy that we have described this species as being a British Coral; the numerous specimens which we have seen were all from Boulogne or Tournay; Prof. M'Coy mentions its existence at Hook, Wexford; at Craigie, near Kilmarnock; at Ronald's-way (Isle of Man); at Kendal, Westmoreland; also near Glasgow; and at Blyth, Ayrshire.

Z. patula belongs to the section of the genus *Zaphrentis*, in which the tabulæ are very largely developed, and the septal fossula well constituted. It much resembles *Z. Ræmeri*,¹ but differs from this species in being less curved, in having thinner and straighter septa, and by its tabula being not so large. *Z. cylindrica*² and *Z. gigantea*,³ that also belong to the same subdivision, differ from it by their large size and numerous septa, and *Z. Halli*⁴ is much more elongate, and has its septal fossula but little developed.

7. ZAPHRENTIS CYLINDRICA. Tab. XXXV, figs. 1, 1a, 1b.

CYATHOPHYLLUM FUNGITES, *Portlock*, Rep. on the Geol. of Londonderry, p. 332, 1843.
(Not *Turbinolia fungites*, Fleming.)

CANINIA GIGANTEA, *Michelin*, Icon. Zooph., p. 81, pl. xvi, fig. 1, 1843.

SIPHONOPHYLLIA CYLINDRICA, *Scouler* in *M'Coy*, Syn. of the Carb. Foss. of Ireland, p. 187, pl. xxvii, fig. 5, 1844.

CANINIA GIGANTEA and SIPHONOPHYLLIA CYLINDRICA, *D'Orbigny*, Prodr. de Pal. Stratigr., vol. i, p. 158, 1850.

ZAPHRENTIS CYLINDRICA, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 339, 1851.

CANINIA GIGANTEA, *M'Coy*, Brit. Palæoz. Foss., p. 89, 1851.

¹ *Milne Edwards* and *J. Haime*, Polyp. Palæoz., p. 341.

² See Tab. xxxv, fig. 1.

³ *Ibid.*, tab. iv, fig. 1; *Caryophyllia gigantea*, *Lesueur*, Mémoires du Muséum, vol. 6, p. 296.

⁴ *Ibid.*, p. 341.

Corallum very long, almost cylindrical, more or less curved, and having large circular accretion swellings. *Septal fossula* rather small in proportion to the size of the visceral chamber, and varying much in its position relative to the bending of the corallum, but always excentric, and placed at a small distance from the wall.

Principal *septa* numerous (at least 60), thin, closely set, almost equal, alternating with an equal number of rudimentary ones, and extending in the form of striae almost to the centre of the calice. *Tabulae* very large, numerous, and closely set. *Interseptal loculi* filled up with vesicular dissepiments, which appear to be independent of the tabulae.

Height of the corallum, 1 foot or more; diameter from 2 inches to $3\frac{1}{2}$; depth of the calice, 1 inch.

The specimens of this gigantic Coral that we have seen, have been found at Swansea; at Easkey, Sligo, at Kulkeag, Fermanagh; at Tournay, in Belgium; and at Sablé, in France. Col. Portlock mentions its existence at Carnteel, Tyrone; and at Clonoë, Donaghmore; and Professor M'Coy has found it at Castleton Bay, Isle of Man. Specimens are in the Collections of the Geological Society, the Museum of Practical Geology, the Cambridge Museum, the Bristol Museum, Mr. Stokes's, &c.

Z. cylindrica belongs to the same section as the preceding species, and approximates to the genus *Amplexus*. It differs from *Z. patula*¹ and *Z. Halli*² by its large size and its numerous septa. By its general form it much resembles *Z. gigantea*,³ but it differs from it by the structure of the interseptal loculi, which are filled with small vesicles; whereas, in the last-named species, they are occupied only by the exterior portion of the tabulae.

8. ZAPHRENTIS (?) SUBIBICINA.

CANINIA SUBIBICINA, M'Coy, Ann. Nat. Hist., 2d ser., vol. vii, p. 167, 1851.

— — M'Coy, Brit. Palæoz. Foss., p. 89, 1851.

“*Corallum* much curved, increasing, when young, at the rate of six lines in one inch, to a diameter of one inch three lines; after which, it remains nearly cylindrical for two or three inches more; surface with a thin, nearly smooth, epitheca, marked with obsolete transverse undulations of growth; when the epitheca is removed, the very fine, equal, costal striae are brought into view, five in two lines at a diameter of one inch two lines; the outer, small, vesicular area, is rather more than a line wide, within which the sixty-five thick primary radiating lamellae extend, about four lines towards the centre, leaving the broad, flat, smooth, slightly undulated central portion of the diaphragms about six lines in diameter in parts of the circumference; short secondary lamellae appear one between each of the primary; lateral siphonal depressions strongly marked; *vertical section* shows the

¹ *Caninia patula*, Michelin, Icon., tab. lix, fig. 4.

² Milne Edwards and J. Haime, Polyp. des Terr. Palæoz., p. 341.

³ Ibid., tab. iv, fig. 1.

outer vesicular area (at about the above diameter) one and a half line wide, composed of about four very oblique rows of small rounded cells, extending upwards and outwards, from the broad deflected edges of the diaphragms, which latter are thick, tolerably regular, nearly horizontal in the middle, about three interdiaphragmatal spaces in two lines.

“Not uncommon in the carboniferous limestone of Kendal.” (*M'Coy*, op. cit.)

This Coral appears to be specifically identical with the fossil which the same author had previously found at Kendal, and had referred to *Cyathophyllum flexuosum* of Goldfuss, under the name of *Caninia flexuosa*;¹ for in speaking of *C. subibicina* he says: “I suspect that this may be the Coral quoted occasionally by authors under the name of the Devonian *Cyathophyllum flexuosum*.” We are also inclined to think that these fossils belong to a species which is found at Tournay, and was described by ourselves under the name of *Zaphrentis tortuosa*.² The description given by Professor M'Coy agrees in most respects with the characteristics of this fossil; but, as no figure of *Z. subibicina* has yet been published, and as some of the peculiarities pointed out by that author (the thickness of the septa, and the great size of the fossula, for example,) do not coincide with what we have observed in *Z. tortuosa*, we have considered it advisable, provisionally at least, to retain here the new specific name given to the British specimens.

Genus AMPLEXUS, (p. lxvi.)

1. AMPLEXUS CORALLOIDES. Tab. XXXVI, figs. 1, 1a, 1b, 1c, 1d, 1e.

AMPLEXUS CORALLOIDES, *Sowerby*, Min. Conchol., vol. i, p. 165, pl. lxxii, 1814.

— — *Bronn*, Syst. der Urw. Konchylien, p. 49, tab. i, fig. 13, 1824.

— SOWERBY, *Phillips*, Geol. of York., vol. ii, p. 203, pl. ii, fig. 24, 1836.

— CORALLOIDES, *De Koninck*, An. Foss. des Terr. Carb. de Belg., p. 27, pl. B, fig. 6, 1842.

— SOWERBY, *M'Coy*, Syn. Carb. Foss. of Ireland, p. 185, 1844.

— CORALLOIDES, *Michelin*, Icon., p. 256, pl. liz, fig. 6, 1846.

— — *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 342, 1851.

— — *M'Coy*, Brit. Palæoz. Foss., p. 92, 1851.

No complete specimens of this species have, to our knowledge, been met with; only fragments, varying in length from 3 lines, to 4 or 5 inches, have been found; but by their general form it is evident, that this corallum is very long, cylindrical, and irregularly bent; it presents, as usual, some circular accretion swellings; its epitheca is in many places worn away, so as to leave uncovered the outer edge of the septa, which form equidistant vertical lines. We have seen no specimens in which the calice was preserved. The *septa* are

¹ Ann. and Mag. of Nat. Hist., 2d series, vol. iii, p. 133.

² *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 335.

equally developed, thin, set wide apart, and quite marginal; they vary in number from 28 to 58, according to the age and the size of the specimens. The *tabulae* are very large, very closely set, and the greatest part of their surface is smooth. A small depression, corresponding to the septal fossula, is visible near the wall, and is always more distinct on the last tabula than on the others.

This species is found in Ireland, near Dublin; at Kildare; at Carlingford, Louth, in the county of Clare; in the Valley of Maine, Kerry; at Killarney, and at Cork. According to Prof. Phillips, it is also met with at Bolland, Kettlewell, Menai Bridge, and in the Isle of Man. We have also seen specimens from Tournay and Visé, in Belgium, Casatchi Datchi in the Oural Mountains, and Varsaw in Illinois, United States.

Specimens are in the Collections of the Geological Society, the Bristol Museum, Mr. Bowerbank, the Paris Museum, M. de Verneuil, &c.

A. coralloides is very remarkable by its elongate cylindroid form. These characters distinguish it at first sight from *A. Henslowi*¹. It never presents any acute transverse ridges, as those seen in *A. nodulosus*,² and *A. annulatus*,³ nor any spines, as in *A. spinosus*.⁴ It much resembles *A. cornubovis*⁵ and *A. Yandelli*,⁶ but differs from them by having the septa less developed, and the septal fossula shallower.

2. AMPLEXUS CORNU-BOVIS.

CYATHOPHYLLUM MITRATUM, (pars,) *De Koninck*, Anim. Foss. des Terr. Carb. de Belg., p. 22, pl. c, fig. 5*d*, (cæter. excl.) 1842. A young specimen. (Not *Hippurites mitratus*, Schlotheim.)

— PLICATUM, (pars,) *Ibid.*, op. cit., pl. c, figs. 4*c*, 4*d*, 4*e*, (cæt. excl.)

CANINIA CORNU-BOVIS, *Michelin*, Icon., p. 185, pl. xlvii, fig. 8, 1845.

CYATHOPSIS CORNU-BOVIS, *D'Orbigny*, Prod. de Pal. Univ., vol. i, p. 105, 1850.

— — *M'Coy*, Brit. Palæoz. Foss., p. 90, 1851.

AMPLEXUS CORNU-BOVIS, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 343, 1851.

Corallum cylindro-conical, very elongate, strongly curved, often somewhat twisted, and presenting well-marked, circular accretion swellings. *Epitheca* much wrinkled. *Calice* rather deep. *Septal fossula* almost round, and placed very near the wall towards the dorsal or convex side of the corallum. Principal *septa* numerous, (about thirty,) very thin,

¹ See tab. xxxiv, fig. 5.

² Phillips, Palæoz. Foss., p. 8; *Amplexus serpuloides*, De Koninck, A. Carb. de Belgique, tab. B, fig. 18.

³ Verneuil and Jules Haime, Bulletin de la Soc. Géol. de France, 2^{de} sér., vol. vii, p. 151; Milne Edwards and Jules Haime, Polyp. Palæoz., p. 345.

⁴ De Koninck, op. cit., tab. c, fig. 1.

⁵ Milne Edwards and Jules Haime, op. cit., tab. ii, fig. 1.

⁶ *Ibid.*, tab. iii, fig. 2.

narrow, equally developed, and alternating with an equal number of smaller ones. *Tabulæ* very large, and to a great extent smooth. Height of the corallum about 3 inches or more; diameter of the *tabulæ* $\frac{3}{4}$ of an inch.

Professor M'Coy mentions having met with this species at Corwen.¹ All the specimens that we have examined were from Tournay, in Belgium.

A. cornu-bovis differs from a *A. Henslowi*² by its elongate cylindrical form; from *A. spinosus*³ by the absence of mural spines, from *A. nodulosus*⁴ and *A. annulosus*⁵ by the form of the circular accretion swellings of the wall, which do not constitute acute ridges; and from *A. Yandelli*,⁶ which it resembles the most, by its septa being more numerous and its general form less irregular.

3. AMPLEXUS NODULOSUS.

AMPLEXUS NODULOSUS, *Phillips*, Palæoz. Foss., p. 8, 1841.

- SERPULOIDES, *De Koninck*, Anim. Foss. des Terr. Carb. de Belg., p. 28, pl. B, figs. 7, 8, 1842.
- NODULOSUS, *M'Coy*, Syn. Carb. Foss. of Ireland, p. 185, 1844.
- SERPULOIDES, *Michelin*, Icon., p. 257, pl. lix, fig. 7, 1846.
- NODULOSUS, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 345, 1851.

Corallum very long, sub-cylindrical, slightly flexuous, covered with a well characterised epitheca, and presenting, at the distance of about one line and a half apart, a series of circular prominent sharp ridges. *Septa* quite marginal; about thirty. Height of the largest fragments about 3 inches; diameter 3 lines.

Professor Phillips discovered this fossil in England, but does not mention the locality in which it was found. Professor M'Coy mentions its existence in Ireland. The specimens which we have seen are from Visé, in Belgium.

This species is remarkable for the prominent circular ridges of its wall; the same character is observable in *A. annulatus*,⁷ but in this latter Coral the mural ridges are not so closely set and a constriction exists above each of them.

¹ Ann. and Mag. of Nat. Hist., 2d series, vol. iii, p. 133.

² See tab. xxxiv, fig. 5.

³ De Koninck, Ann. Foss. des Terr. Carb. de Belgique, tab. c, fig. 1.

⁴ Phillips, Palæoz. Fossils, p. 8; *Amplexus serpuloides*, De Koninck, op. cit., tab. B, figs. 7, 8.

⁵ De Verneuil and J. Haime, in Bull. de la Soc. Géol. de France, s. 2, vol. vii, p. 151; *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 345.

⁶ *Milne Edwards* and *Jules Haime*, op. cit., tab. iii, fig. 2.

⁷ De Verneuil and J. Haime, in Bullet. de la Soc. Géol. de France, s. 2, vol. vii, p. 151; *Milne Edwards* and *Jules Haime*, Polyp. des Terr. Palæoz., p. 345.

4. AMPLEXUS SPINOSUS.

AMPLEXUS SPINOSUS, *De Koninck*, Ann. Foss. des Terr. Carb. de Belg., p. 28, pl. c, fig. 1, 1842.

CYATHAXONIA SPINOSA, *Michelin*, Icon., p. 257, pl. lix, fig. 10, 1846.

— — *D'Orbigny*, Prod. de Pal., vol. i, p. 158, 1850.

CALOPHYLLUM SPINOSUM, *M'Coy*, Brit. Palæoz. Foss., p. 91, 1851.

AMPLEXUS SPINOSUS, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 346, 1851.

Corallum elongate, cylindro-turbinate, somewhat twisted, acute at its basis, with a rudimentary epitheca and but slightly developed circular accretion swellings. *Costal ridges* flat, sub-equal, closely set, smooth towards the upper part of the corallum, but in the basal half of this armed with a series of small ascendant spines. *Calice* rather deep. *Septal fossula* small. Upper tabula not very broad, especially in young specimens, and sometimes protruding a little in the cavity of the calice. Principal *septa* not numerous, (sixteen,) very thin, very narrow upwards, presenting a concave denticulated edge inwards, slightly bent towards the centre of the corallum, and alternating with an equal number of very small ones. Height of the corallum about 2 inches; diameter of the calice about 5 lines.

Found in the black carboniferous shale at Poolwart, Isle of Man, and at Tournay, in Belgium. Specimens are in the collections of the Cambridge Museum, the Paris Museum, the Ecole des Mines, M. de Verneuil, &c.

This Coral is distinguished from all the other species of *Amplexus* by the spines which are developed on the surface of the lower part of its wall.

5. AMPLEXUS HENSLOWI. Tab. XXXIV, figs. 5, 5a.

CYATHOPHYLLUM CERATITES, *Michelin*, Icon. Zooph., p. 181, pl. xlvii, fig. 3, 1845. (Not Goldfuss.)

AMPLEXUS HENSLOWI, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 346, pl. x, fig. 3, 1851.

Corallum turbinate, not very elongate, not strongly curved, and having but slight circular accretion swellings. *Epitheca* probably delicate, and when worn off leaving uncovered numerous flat equally developed costæ. *Calice* filled up with extraneous matter in all the specimens examined, but appearing to be deep. *Tabulae* irregularly developed, large, sloping downwards towards the ventral or concave side of the corallum, and reaching almost from wall to wall. *Septa* appearing to be numerous, narrow, and unequal alternately. *Septal fossula* not observable, on account of the filling up of the calice. Height of the corallum in the large specimens 3 inches; diameter of the calice 2 inches or more.

A specimen of this *Amplexus* was found by Professor Henslow in the Isle of Man, and placed by that geologist in the collection of the Geological Society. The same species is found at Visé, in Belgium, and near Boulogne, in France.

The *AMPLEXUS TORTUOSUS* of Phillips,¹ which is a fossil of the Devonian formation, is mentioned by Professor M'Coy as existing also in the carboniferous deposits of Ireland.² We have not had an opportunity of examining these corals.

3. *Genus* LOPHOPHYLLUM, (p. lxvi.)

LOPHOPHYLLUM (?) ERUCA.

CYATHOPSIS (?) ERUCA, *M'Coy*, Ann. Nat. Hist., 2d Ser., vol. vii, p. 167, 1851; Brit. Palæoz. Foss., p. 90, 1851.

"*Corallum* very small, sub-cylindrical, after a diameter of three lines, diameter three lines and a half; surface marked with coarse, longitudinal, obtuse lamellar striæ, three in the space of one line; radiating lamellæ strong, slightly irregular, connected by several curved, thick, transverse, vesicular plates in the horizontal section, one of the lamellæ stronger than the rest, and extending through the centre, where it is either thickened or confounded with a slight mesial boss of one of the transverse septa, vertical section, middle third traversed by thick, sub-regular, transverse diaphragms, convex upwardly, three inter-diaphragmatal spaces in one line; outer third on each side formed of one or two rows of irregular large cells, formed by the junction and occasional duplicature of the deflected edges of the diaphragms.

"Very common in the black carboniferous limestone and shale of Beith, Ayrshire."
(*M'Coy*, op. cit.)

It appears evident, by this description, that the Coral here mentioned must belong to the genus *Lophophyllum*, and is, probably, specifically different from the Belgian fossils, which were previously known as appertaining to the same division, for Professor M'Coy says that by its external character it bears the most exact resemblance to *Cyathaxonia cornu*, whereas *Lophophyllum Konincki*³ and *L. Dumonti*⁴ are much more conical and less curved. Professor M'Coy refers this fossil to M. D'Orbigny's genus *Cyathopsis*, which is defined by that geologist as being formed of corals resembling *Amplexus*, but with a septal fossula,

¹ Palæoz. Fossils, p. 8, tab. iii, fig. 8.

² Syn. Carb. Foss. of Ireland, p. 185.

³ Milne Edwards and Jules Haime, Polyp. des Terr. Palæoz., p. 349, tab. iii, fig. 4.

⁴ Ibid., p. 350, tab. iii, fig. 3.

but we have been enabled to ascertain that this last-mentioned character exists in all true *Amplexus*, and that no other organic peculiarity distinguish these from the typical form of *Cyathopsis*; we have, therefore, not adopted the new generical name proposed by M. D'Orbigny and employed by Professor M'Coy. We must also remark that the latter author places in the genus *Cyathopsis*, together with this *Lophophyllum*, two species of true *Zaphrentis*, and we do not well understand on what grounds he has proceeded in so doing, or how to interpret the apparent contradictory statements relative to the characters of *Cyathopsis*, when Professor M'Coy, after having said "These corals differ from *Caninia* (or *Zaphrentis*) in wanting the outer perithecal small vesicular area or lining of the walls," adds that they differ "from *Calophyllum*, (which I only know by name,) by the vesicular edge of the transverse plates between the lamellæ at the walls," &c.

Sub-Family CYATHOPHYLLINÆ, (p. lxvii.)

1. *Genus* CYATHOPHYLLUM, (p. lxviii.)

1. CYATHOPHYLLUM MURCHISONI. Tab. XXXIII, figs. 3, 3a, 3b.

PALÆOSMILIA MURCHISONI, *Milne Edwards* and *Jules Haime*, Ann. Sc. Nat., 3^me serie, vol. x, p. 261, 1848.

STREPHODES MULTILAMELLATUM, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d series, vol. iii, p. 5, 1849.

CYATHOPHYLLUM MURCHISONI, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 369, 1851.

STREPHODES MULTILAMELLATUM, *M'Coy*, Brit. Palæoz. Foss., p. 93, pl. iii c, fig. 3, 1851.

Corallum very long, sub-cylindrical, curved, very slightly compressed, and bearing strong circular swellings placed at about 2 or 3 lines apart. *Calice* somewhat oval; its two diameters as 100:130, and its long diameter corresponding to the curve of the corallum. *Septa* very thin, very closely set, almost equal, numerous (about 150), straight or slightly bent, and reaching to the centre of the calice. A vertical section shows that the *tabulæ* are very small and distant; the vesicular dissepiments very small and almost vertical, and the septa well developed. Height of the *corallum*, 7 inches; great diameter of the *calice* 2 inches, small diameter $1\frac{1}{2}$ inch.

Found at Frome, Somersetshire; Tyn-y-castle, Clifton, and Mold. Professor M'Coy mentions its existence at Arnside, Kendal, and Lisardrea, Boyle, Roscommon.

Specimens are in the Collections of the Bristol Museum, the Museum of Practical Geology, the Geological Society, the Cambridge Museum, Mr. Bowerbank, Mr. Stokes, and the Museum of Paris.

Before we were enabled to ascertain the internal structure of this *Corallum* by means

of a vertical section, we had been misled by its external characters, and had placed it in the vicinity of the genus *Montlivaultia*, under the generic name of *Palæosmilæa*.¹ A vertical section shows what are its real zoological affinities, and we do not think that this fossil ought to be distinguished from the true *Cyathophylla*, which correspond nearly to the *Strephodes* of Professor M'Coy.

C. Murchisoni differs from most of the simple species of the same generical division by the smallness of its tabulæ and the thinness of its septa. It much resembles *C. Wrighti*,² but this latter Coral is more compressed, harder, and has stronger septa. It is also closely alluded to *C. Stutchburyi*,³ which differs from it by the septa being stronger and less numerous, and by having a rudimentary septal fossula.

2. CYATHOPHYLLUM WRIGHTI. Tab. XXXIV, figs. 6, 6a.

CYATHOPHYLLUM WRIGHTI, *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 370, 1851.

This species much resembles the preceding one, but the corallum is shorter, very much compressed towards the calice, and bent near its basis only. *Calice* elongate in the direction of the curve, flat near its edge, and with a narrow somewhat shallow central depression; proportion of the short and long diameter of the calice 100 : 200, or even 220. *Septa* numerous, (at least 130,) somewhat unequal alternately, thin and straight, or slightly curved inwardly. Height of the corallum $3\frac{1}{2}$ inches; calice: great diameter $2\frac{1}{2}$ inches; short diameter 1 inch.

Found at Frome, Somersetshire. Specimens are in the collections of Mr. Bowerbank and of Dr. Wright (Cheltenham).

The compressed form which exists in this species is very rarely met with in *Cyathophyllum*. *C. angustum*,⁴ the transverse section of which is also oblong, is not bent at its basis as *C. Wrighti* is, and its septa are not so closely set.

3. CYATHOPHYLLUM STUTCHBURYI. Tab. XXXI, figs. 1, 1a, 2, 2a, and Tab. XXXIII, fig. 4.

TURBINOLIA FUNGITES, *Phillips*, Geol. of Yorkshire, 2d part, p. 203, pl. ii, fig. 23, 1836.
(Not *T. fungites*, Fleming.)

— EXPANSA, *M'Coy*, Syn. Carb. Foss. of Ireland, p. 186, pl. xxviii, fig. 7, 1844.

CYATHOPHYLLUM EXPANSUM, *D'Orbigny*, Prod. de Palæont., vol. i, p. 159, 1850. (Not Fischer.)

— STUTCHBURYI, *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 373, 1851.

¹ Comptes-rendus de l'Académie des Sciences, 1848, vol. xxvii, p. 467.

² See tab. xxxiv, fig. 6.

³ See tab. xxxi, figs. 1, 2; tab. xxxiii, fig. 4.

⁴ Lonsdale, in Murchison's Silurian Syst., tab. xvi, fig. 9.

Corallum straight, or but very slightly curved; sometimes as broad as high, in other specimens very elongate, and having well characterised circular accretion swellings at unequal distances. *Calice* almost circular, with a small, shallow, central cavity, near which some appearance of a small septal fossula is sometimes visible; a broad convex elevation surrounding this central depression, and the exterior portion of the calice forming a flat or somewhat concave zone. *Septa* numerous, (120 to 140), well developed, somewhat unequal alternately, thin, closely set, and for the most part quite straight; the principal ones reach to the centre of the calice, the others almost as far. Specimens 8 or 10 inches long are not uncommon; but others, in which the calice is equally broad, are not more than two inches high.

Found at Bristol, Lilleshall, Clifton, and, according to Professor Phillips, also at Bolland, Ribbleshead, Penyghent, Bowes, Hawes, Coverdale, Brough, Ashfell, Orton, in Northumberland, Durham, Derbyshire, Florence Court, Stradone, and Ireland. Specimens are in the collections of the Geological Society, of the British Museum, of Professor Phillips, at York, of the Paris Museum, and of M. de Verneuil.

This coral remains always simple, but bears great affinity to *C. helianthoides*¹ and *C. regium*;² but its tabulæ are larger than in either of these species, and its septa are also more numerous than in the first. It differs also from *C. Murchisoni*³ by the great development of the tabulæ and the thickness of its septa.

4. CYATHOPHYLLUM REGIUM. Tab. XXXII, figs. 1, 1a, 2, 3, 4, 4a.

CYATHOPHYLLUM REGIUM, *Phillips*, Geol. of Yorkshire, 2d part, p. 201, pl. ii, figs. 25, 26, 1836.

ASTREA CARBONARIA, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d Ser., vol. iii, p. 125, 1849.

FAVASTREA REGIA, *D'Orbigny*, Prodr. de Palæont., vol. i, p. 160, 1850.

CYATHOPHYLLUM REGIUM, *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Pal., p. 376, 1851.

ASTREA (PALASTRÆA) CARBONARIA, *M'Coy*, Brit. Pal. Foss., p. 111, pl. 3 A, figs. 7 and 3 B, fig. 1, 1851.

Corallum compound, massive and astreiform. *Calices* polygonal, very unequal in size, and separated by simple linear ridges; their central depression large but not deep, and surrounded by a circular tumefaction; their exterior portion flat or somewhat concave. *Septa* numerous (120 to 130), very thin, closely set, sub-geminate, almost equal exteriorly, but alternatively extending more or less internally; some not reaching quite to the centre of the calice, the others uniting and becoming slightly flexuous, and exsert there, so as to constitute a kind of false columella of an oblong form, that bears a small longitudinal sulcus resembling a rudimentary septal fossula. Diagonal of the calices varying from 1 to 3 inches.

¹ Goldfuss, Petref. Germ., vol. i, tab. xx, fig. 2; tab. xxi, fig. 1.

² See tab. xxxii, figs. 1, 2, 3, 4.

³ See tab. xxxiii, fig. 3.

Found at Bristol, Corwen, Lofthouse in Nidderdale; its existence in Pembrokeshire and Wrekin is mentioned by Professor Phillips, and at Bakewell, Derbyshire, by Professor M'Coy. Specimens are in the collections of the Museum of Practical Geology, of Bristol, of Cambridge, of Professor Phillips, at York, of the Paris Museum, &c.

This coral is liable to some variations in form, which are shown in the figures given in this Monograph. The circular elevation which usually circumscribes the central calicinal fossula, and which is shown in fig. 1, does not exist in the specimen represented in fig. 3, and in the specimens represented in figs. 2 and 4*a*, the bottom of the fossula is become prominent. In the specimen, fig. 3, the corallites are pressed very closely together, and the intercalicular mural ridges are very thin and sharp, whereas in figs. 1 and 2 the approximation of the corallites not being carried so far, the mural ridges are thick and blunt. We may also remark, that in the specimen fig. 3 the septa are thicker than usual, but that peculiarity appears to be dependent on the process of fossilisation only.

C. regium much resembles *C. helianthoides*,¹ but in the specimens where the corallites remain free laterally, these are of an almost regular turbinate form, and their calice is not inverted exteriorly, so as to assume the form of a mushroom, as is always the case in *C. helianthoides*; the septa are also thinner and more numerous in the above described species than in the latter-mentioned one.

CYATHOPHYLLUM CRENULARE, of Phillips,² appears not to differ specifically from *C. regium*, and to be only a variety with smaller calices. According to Professor Phillips this fossil is found at Clithero, Mendip, Bristol, and in Derbyshire.

5. CYATHOPHYLLUM PARRICIDA. Tab. XXXVII, figs. 1, 1*a*, 1*b*.

CYATHOPHYLLUM PARACIDA, M'Coy, Ann. and Mag. of Nat. Hist., 2d ser., vol. iii, p. 7, 1849; Brit. Palæoz. Foss., p. 86, pl. iii *c*, fig. 9, 1851.

— — — Milne Edwards and Jules Haime, Pol. Foss. des Terr. Palæoz., p. 385, 1851.

Corallum fasciculate and increasing by calicinal gemmation; the large calices bearing three or four young corallites, which smother by their growth their parent. The corallites free laterally, conical or cylindroid, and not bearing circular accretion swellings. *Calices* circular. *Septa* not numerous (32), almost equal, thin, and united exteriorly by vesicular dissepiments. *Tabulæ* large and horizontal. Diameter of the corallum from 3 to 5 lines.

From Mold, Derbyshire. Specimens are in the collection of the Museum of Practical Geology, of Cambridge, and of Paris.

¹ Goldfuss, Petref. Germ., vol. i, tab. xx, fig. 2, and tab. xxi, fig. 1.

² Geol. of Yorkshire, 2d part, pl. ii, figs. 27, 28; *Astrea crenularis*, M'Coy, Syn. of Carb. Foss. of Ireland, p. 187; *Actinocyathus crenularis*, D'Orbigny, Prod., vol. i, p. 160.

This species differs from all the other corals belonging to the same generical division by the great extent of the tabulæ, and in that respect much resembles *Amplexus* and *Campophyllum*; it may possibly in reality appertain to this last-mentioned genus, which bears to *Cyathophyllum* similar relationship as *Amplexus* does to *Zaphrentis*, but the specimens which we have had an opportunity of examining were not in a state of preservation sufficiently perfect to enable us to ascertain whether the smooth appearance of the tabulæ was due to the absence of septal prolongations or the accidental destruction of their radii.

6. CYATHOPHYLLUM? PSEUDO-VERMICULARE.

CYATHOPHYLLUM PSEUDO-VERMICULARE, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d Series, vol. iii, p. 8, 1849.

— — — *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 388, 1851.

— — — *M'Coy*, Brit. Palæoz. Foss., p. 86, pl. iii c, fig. 8, 1851.

“Elongate, cylindrical, flexuous; surface very irregularly annulated or transversely nodular, coarsely striated longitudinally (about six striæ in one fourth of an inch); branches averaging from half to three fourths of an inch in diameter; small cylindrical branches project at distinct irregular intervals from the sides; *internal structure*;—central area, rather more than half the diameter of the tube, defined, composed of flat, slightly undulated transverse *septa*, bent downwards at the end, bearing at their circumference a series of from 24 to 27 very short, equal, rather distant, radiating lamellæ, *not* reaching half way to the centre; interval between this inner area and the walls filled with loose cellular structure, formed of little more than a single row of large vesicular curved plates, highly inclined upwards and outwards. Not uncommon in the lower carboniferous limestone of Kendal, Westmoreland; (a variety also occurs in the lower carboniferous limestone of Kiltullagh, Roscommon, Ireland).” (*M'Coy*, *op. cit.*)

7. CYATHOPHYLLUM DIANTHOIDES.

CYATHOPHYLLUM DIANTHOIDES, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d Series, vol. iii, p. 7, 1849.

— — — *Milne Edwards* and *Jules Haime*, Polyp. Foss. des Terr. Palæoz., p. 390, 1851.

— — — *M'Coy*, Brit. Palæoz. Foss., p. 85, pl. iii c, fig. 7, 1851.

Corallum compound, forming wide conical masses, increasing by calicular gemmation, and very prolific (from 8 to 16 young corallites rising sometimes from one parent calice). *Corallites* conico-cylindrical. *Septa* numerous, (96 or 100,) thin, straight, crenulate, and somewhat unequal in extent alternatively. *Tabulæ* large, nearly horizontal,

somewhat vesicular at certain parts; interseptal vesicular dissepiments abundant and pretty regular. Diameter of the *calices* from 6 lines to 1 inch or more. Found at Arnside and Kendal, Westmoreland.

Specimens are in the Cambridge Museum. This species, by its general aspect, much resembles *Cyathophyllum truncatum*¹ of the Wenlock rocks, but its septa are much thinner, and its corallites more cylindrical.

CYATHOPHYLLUM ARCHIACIS. Tab. XXXIV, fig. 7.

Corallum simple, conical; somewhat elongate, curved, very slightly compressed, and presenting a few slight, broad, circular accretion swellings. Epitheca thin. *Calice* oval, with a lamellate edge, a rather deep cavity, and a rudimentary, elongate, septal fossula. Septa very numerous, very thin, closely set, and appearing to be somewhat unequal alternately; towards the centre of the calice they project a little, so as to constitute paliform lobes, which, by their agglomeration, form an oblong ridge. Height of the corallum about 6 inches; long diameter of the calice about $3\frac{1}{2}$ inches; depth of the calice $1\frac{1}{2}$ or 2 inches.

Found in the carboniferous limestone, at Llanymynch, by Sir Roderick I. Murchison. The specimen here figured belongs to the Collection of the Geological Society.

This species differs from all the other simple *Cyathophylla*, by the oval form of its calice, its paliform lobes, and its rudimentary septal fossula. The fossil which Professor M'Coy² has referred to the *Clisiophyllum multiplex* of Keyserling³ appears to belong to this species; it was found at Kendal, Westmoreland.

Professor M'Coy⁴ states that *TURBINOLOPSIS BINA*, *T. CELTICA*, *T. PAUCIRADIALIS*, and *T. PLURIRADIALIS* of Professor Phillips, which appertain to the genus *Cyathophyllum*, and belong to the Devonian formation, are also met with in the carboniferous deposits in Ireland; but as he has given neither description nor figures of the Corals alluded to, we entertain great doubts relative to the exactness of these determinations.

¹ Polyp. Foss. des Terr. Palæoz., p. 379.

² Brit. Palæoz. Foss., p. 95.

³ Petschora, tab. ii, fig. 1.

⁴ Syn. of Carb. Foss. of Ireland, p. 186.

2. *Genus* CAMPOPHYLLUM, (p. lxviii.)

CAMPOPHYLLUM MURCHISONI. Tab. XXXVI, figs. 2, 2a, 3.

CAMPOPHYLLUM MURCHISONI, *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 396, 1851.

Corallum somewhat elongate, curved, but not twisted, and bearing but slight circular accretion ridges. Principal *septa* rather numerous (66), not very thin, rather unequal alternately; an equal number of rudimentary ones. *Tabulæ* very broad; lateral vesicules small, not numerous, and forming only two or three vertical rows.

Height of the corallum 3 or 4 inches; diameter of the calice about 2 inches.

Specimens of this Coral are in the Collections of the Geological Society and of the Bristol Museum, but we do not know in what part of England they were found.

This species differs from *C. flexuosum*,¹ by its general form, which is not remarkably elongate nor flexuous; and from *C. Duchatelei*,² by its *septa* being more numerous, and its interseptal vesicules less abundant.

3. *Genus* CLISIOPHYLLUM, (p. lxx.)

1. CLISIOPHYLLUM TURBINATUM. Tab. XXXIII, figs. 1, 1a, 2.

TURBINOLIA FUNGITES (PARS)? *Fleming*, Brit. Anim., p. 510, 1828.CYATHOPHYLLUM FUNGITES, *De Koninck*, An. Foss. des Terr. Carb. de Belg., p. 24, pl. D, fig. 2, 1842.CLISIOPHYLLUM TURBINATUM, *M'Coy*, Ann. Nat. Hist., s. 2, vol. vii, p. 169, 1851.— KONINCKI, *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 410, 1851.— TURBINATUM, *M'Coy*, Brit. Palæoz. Fossils, p. 88 and 96, figs. a, b, c, 1851.

Corallum conical, curved, sometimes rather short and stout, in other specimens long and slender; circular accretion ridges thick and irregular; epitheca strong. Calice circular, rather deep, with a thin, everted edge. Forty-four thin, principal *septa*, half of which project towards the centre, and bend slightly on the sides of a well-developed lamellar *columella*. Rudimentary *septa* alternating with the principal ones. A vertical section shows, that the exterior area of the visceral chamber is occupied by long, oblique vesicules;

¹ *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz., pl. viii, fig. 4.—*Cyathophyllum flexuosum*, Goldfuss, Petref. Germ., vol. i, tab. xvii, fig. 3.

² *Milne Edwards and Jules Haime*, op. cit., p. 396.

that the central area is distinct from the preceding one; and that, in the central area, the oblique lines, resembling a small tent, indicate the position of the small tabulæ which are crossed by the principal septa.

Height of the corallum (in the large specimens) $2\frac{1}{2}$ inches; diameter of the calice very variable.

Found at Oswestry; Nunney, near Frome; Castleton, Derbyshire; Wellington, in Shropshire; and, according to Professor M'Coy, at Beith, Ayrshire.

Specimens are in the Collections of the Museum of Practical Geology, of Bristol, of Mr. Bowerbank, &c.

This species is characterised by its well-developed *columella*, and the very regular arrangement of its *septa*.

The Fossil mentioned by Col. Portlock under the name of *Turbinolia mitrata*,¹ and found by that Geologist in the carboniferous formation at Benburb, appears to belong to this species.

2. CLISIOPHYLLUM CONISEPTUM. Tab. XXXVII, figs. 5, 5a.

CYATHOPHYLLUM CONISEPTUM, *Keyserling*, Reise in Petschora, p. 164, pl. ii, fig. 2, 1846.

CYATHAXONIA CONISEPTA, *D'Orbigny*, Prodr. de Pal., t. i, p. 158, 1850.

CLISIOPHYLLUM CONISEPTUM, *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 411, 1851.

Corallum cylindro-conical, very tall, curved, and presenting well-marked, but small accretion ridges. *Calice* circular. *Columellarian* protuberance conical, prominent, and bearing at its summit a small columellarian lamella. *Septa* not very numerous (60 or 70), thin, unequally developed alternately, some of the largest advancing quite to the centre of the calice, and ascending the columellarian protuberance, under the form of flexuous ridges.

Height of the corallum, in general, 3 or 4 inches, and diameter of the calice about $1\frac{1}{2}$ inch; sometimes much larger.

Found at Ticknell, Mold, and Corwen, in England; and, according to Count Keyserling, at Ylytsch in Russia. The large specimen figured in this Monograph belongs to the Collection of the Bristol Museum.

This species is remarkable for its elongate, cylindro-conical form, the smallness of the central lamina placed at the top of the columellarian protuberance, and the great development of this conical protuberance itself. *C. coniseptum* differs also from *C. Hisingeri*² by

¹ Report on the Geology of Londonderry, p. 331.

² Milne Edwards and Jules Haime, Monogr. des Polyp. des Terr. Palæoz., tab. vii, fig. 5.

its *septa* being more numerous and flexuous inwardly, and from *C. Bowerbanki*,¹ by the irregular arrangement of the *septa* near the columellarian protuberance. *C. Keyserlingi*² is more bent, has larger accretion ridges, the interseptal loculi more vesicular, and the *septa* being less numerous.

3. CLISIOPHYLLUM BOWERBANKI. Tab. XXXVII, figs. 4, 4a.

CLISIOPHYLLUM BOWERBANKI, *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 411, 1851.

Corallum conical, elongate, curved, very narrow at its basis, and presenting but very slight circular accretion swellings. *Calice* circular. *Septa* 70, or more; the principal ones rising up towards the centre of the corallum, where they become flexuous; eight of them larger than the rest, and reaching to the top of the columellarian protuberance. Height of the corallum about $2\frac{1}{2}$ inches; diameter of the calice about 12 or 14 lines.

The specimen here described was found in the Carboniferous Deposits of Ireland, and belongs to the collection of our friend, Mr. J. S. Bowerbank.

This species is characterised principally by the unequal development of its principal *septa*, eight of which only extend to the top of the columellarian protuberance. It most resembles *C. coniseptum*,³ but independently of its being much shorter, it differs from this Coral by its *septa* being much more numerous in proportion to the size of the visceral chamber.

CLISIOPHYLLUM BIPARTITUM of Professor M'Coy,⁴ much resembles this species, but appears to differ somewhat from it by the mode of arrangement of the principal *septa*. It was found in Derbyshire.

4. CLISIOPHYLLUM KEYSERLINGI.

CLISIOPHYLLUM KEYSERLINGII, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d series, vol. iii, p. 2, 1849.

— — — *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 412, 1851.

— — — *M'Coy*, Brit. Palæoz. Foss., p. 94, pl. iii c, fig. 4, 1851.

Corallum conical, and very elongate; curved, and presenting rather strong circular swellings. *Calice* circular. *Columellarian protuberance* conical, and formed by the prolongation of the principal septal radii, twisted round the axis of the corallum. Principal

¹ See tab. xxxviii, fig. 4.

² Professor M'Coy, Ann. and Mag. of Nat. Hist., s. 2, vol. iii, p. 2.

³ See tab. xxxvii, fig. 5.

⁴ Ann. and Mag. of Nat. Hist., s. 2, vol. iii, p. 2.

septa forty or fifty in number, rather thick in their outer half, and alternating with an equal number of very small ones. The exterior portion of the corallum very vesicular; the columellarian area very distinct. Height of the corallum from 3 to 5 inches. Diameter of the calice about $1\frac{1}{2}$ inch or more.

Found at Oswestry, Derbyshire, and at Visé, in Belgium. Specimens in the Collections of the Museum of Practical Geology, of Bristol, and of Paris. The British specimens communicated to us for the preparation of this Monograph, were not in a sufficiently good state of preservation to be figured.

C. Keyserlingi differs from all the other species of the same genus, except *C. Danaanum*,¹ by its *septa* being rather thick, and its walls tumefied; it differs also from the latter, in having the *septa* more numerous and more unequal.

5. CLISIOPHYLLUM? COSTATUM.

CYATHAXONIA COSTATA, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d series, vol. iii, p. 6, 1849.

CLISIOPHYLLUM COSTATUM, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 412, 1851.

CYATHAXONIA COSTATA, *M'Coy*, Brit. Palæoz. Foss., p. 109, pl. iii c, fig. 2, 1851.

This species has been established for a small coral, which appears to be a young *Clisiophyllum*, and belongs probably to one of the preceding ones, although we are not able to determine its precise specific character. It is conical, with a circular calice containing twenty-six *septa*. It is about 1 inch high, and 3 lines in diameter at the calice.

Found in Derbyshire, and belonging to the Cambridge Museum.

6. CLISIOPHYLLUM BIPARTITUM.

CLISIOPHYLLUM BIPARTITUM, *M'Coy*, Ann. Nat. Hist., 2d series, vol. iii, p. 2, 1849.

— — — *M'Coy*, Brit. Palæoz. Foss., p. 93, pl. iii c, fig. 6, 1851.

“Very elongate, conic, nearly cylindrical, with a diameter of one and a quarter inch, for the greater part of its length; strongly and regularly striated externally (about five *striæ* in one fourth of an inch); external *striæ* corresponding in number to the radiating lamellæ; in the transverse rough section, the central area is rather more than one third the whole diameter, composed of the edges of confusedly-blended vesicular plates, crossed by a few faint extensions of the radiating lamellæ, and divided into two symmetrical portions by a strong median fissure; the space between this inner area and the outer wall is narrow and regularly radiated with about fifty-eight equal, thin, rather distant

¹ *Milne Edwards* and *Jules Haime*, Polyp. des Terr. Palæoz., p. 412.

lamellæ, connected by numerous delicate transverse vesicular plates; between each pair at the circumference, a shorter radiating lamella occurs, which only reaches half way to the axis, and where they occur, the connecting vesicular plates are smaller and more numerous than from thence to the axis, the intermediate open cellular space less than the outer one in width; *vertical section* indistinctly triareal; outer area defined, about one sixth of the width on each side, composed of small, much curved, vesicular plates, forming minute semicircular cells, arranged in very oblique rows upwards and outwards, about seven in a row; middle zone rather less than the outer one in width, passing gradually into the central structure, formed of few larger and less-curved vesicular plates than the outer zone, and having a nearly horizontal direction, one or one and a half reaching across the space; central area composed of large, thin, close, little curved vesicular plates, forming a strongly arched series of narrow, elongate cells, the convexity of the arch upwards, conforming to the shape of the central boss in the cup. If the vertical section be at right angles to the medial fissure, or crest of the central boss, there is a line visible down the middle of the section; *terminal cup* deep, lined by the vertical lamellæ, and having a large oval prominent boss in the centre, traversed by a sharp mesial crest; about one half or one third of the radiating lamellæ ascend the central boss, always in a direct line, those at the sides of the mesial crest being at right angles to it, the others joining at a more acute angle at the approach of the extremity; and, opposite one end of the crest, we generally observe one or two of the radiating lamellæ shorter than the rest, producing a sort of siphon-like irregularity, such as we see in *Caninia* (Zaphrentis).

“In the Carboniferous Limestone of Derbyshire; Shale of Beith, Ayrshire.” (*M'Coy*, op. cit.)

4. *Genus* AULOPHYLLUM, (p. lxx.)

1. AULOPHYLLUM FUNGITES. Tab. XXXVII, fig. 3.

FUNGITES, *David Ure*, History of Rutherglen and East Kilbride, p. 327, pl. xx, fig. 6, 1793.

TURBINOLIA FUNGITES, *Fleming*, Brit. Anim. p. 510, 1828.

— — *S. Woodward*, Syn. Table of Brit. Org. Rem., p. 7, 1830.

CYATHOPHYLLUM FUNGITES, *Geinitz*, Grund. der Verst., p. 571, 1845-6.

CLISIOPHYLLUM PROLAPSUM, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d series, vol. iii, p. 3, 1849.

AULOPHYLLUM PROLAPSUM, *Milne Edwards* and *Jules Haime*, Brit. Foss. Corals, Introd., p. lxx, 1850.

AULOPHYLLUM FUNGITES, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 413, 1851.

CLISIOPHYLLUM PROLAPSUM, *M'Coy*, Brit. Palæoz. Foss., p. 95, pl. iii c, fig. 5, 1851.

Corallum elongate, cylindro-conical, subpedicellate, curved, presenting small circular accretion ridges, and covered with a well-developed epitheca. Calice not known; upper

end of the corallum almost circular. The circle formed by the inner wall, only half the size of that formed by the outer wall. Septo-costal radii numerous, about 180, thin, almost straight, and unequal in size, alternatively; half of them only pass through the inner wall, and extend to the centre of the visceral chamber; the others occupy only the external zone. Height of the *corallum* about 4 inches; diameter of the exterior wall about 13 lines, that of the inner wall being 4 lines. Found at Kildare and in Derbyshire. Specimens are in the Collections of the Museum of Bristol, Cambridge, and Paris.

Professor M'Coy, in his recently published work on 'Palæozoic Fossils,' rejects the genus *Aulophyllum*, that we had previously proposed the existence of; the inner wall being, as he remarks, "merely a question of degree." That is very true, but we considered such a difference in the degree of development of the constituent part of the corallum as being of sufficient value to authorise generic distinction, because we do not find any gradual passage between the organic form belonging to *Cyathophyllum*, in which the inner wall is rudimentary, or does not exist at all, and that peculiar to *Aulophyllum*, where the inner wall is greatly developed, and almost central. As to the genus *Clisiophyllum*, to which Professor M'Coy refers the above-described corals, it differs from our genus *Aulophyllum*, not only by the characters here alluded to, but also by the central elevation of the tabulæ, and the existence of a true *sublamellar columella*.

Aulophyllum fungites differs from *A. Bowerbanki*¹ by its septa being more numerous, and its inner wall wider in proportion to the diameter of the corallum.

Professor M'Coy² mentions a small variety of this species, found in the carboniferous limestone of Lowick, Northumberland; and at Beith, Ayrshire.

2. AULOPHYLLUM BOWERBANKI. Tab. XXXVIII, fig. 1.

AULOPHYLLUM BOWERBANKI, *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 414, 1851.

Corallum very elongate, subcylindrical, curved, and presenting laterally a prominent line that appears to correspond to a series of rudimentary septal fossulæ. Diameter of the inner wall about half that of the corallum. *Septo-costal lamellæ* about 120 in number, unequal in size alternatively; the large ones rather thick.

The specimen here described was broken at both extremities, but it may easily be seen that its height must have been at least 10 inches. It was found in the Carboniferous Limestone in Ireland, and belongs to Mr. Bowerbank's collection.

¹ See tab. xxxviii, fig. 1.

² Op. cit., p. 96.

5. Genus LITHOSTROTION.¹

1. LITHOSTROTION BASALTIFORME. Tab. XXXVIII, figs. 3, 3a, 3b.

LITHOSTROTION, *Luid*, Lithophyllacii Britannici Ichnographia, epistola 5, tab. xxiii, 1760.

— *Parkinson*, Org. Rem., vol. ii, pl. ix, figs. 3 and 6, 1808.

ASTREA BASALTIFORMIS, *Conybeare* and *William Phillips*, Outlines of Geol. of Engl. and Wales, p. 359, 1822.

ASTREA ARACHNOIDES, *Defrance*, Dict. Sc. Nat., vol. xlii, p. 383, 1826.

LITHOSTROTION STRIATUM, *Fleming*, Brit. Anim., p. 508, 1828.

COLUMNARIA STRIATA, *De Blainville*, Dict. Sc. Nat., vol. lx, p. 316, 1830.—*Man. d'Actin.*, p. 360, pl. lii, fig. 3.

LITHOSTROTION STRIATUM, *S. Woodward*, Syn. Table of Brit. Org. Rem., p. 5, 1830.

CYATHOPHYLLUM BASALTIFORME, *Phillips*, Geology of York, vol. ii, p. 202, pl. ii, figs. 21, 22, 1836.

COLUMNARIA STRIATA, *Milne Edwards*, Ann. de la 2de edit. de Lamarck, vol. ii, p. 343, 1836.

ASTREA HEXAGONA, *Portlock*, Rep. on the Geol. of Londonderry, &c., pp. 332, pl. xxiii, fig. i, 1843.

ASTREA BASALTIFORMIS, *Ibid.*, p. 333.

LITHOSTROTION STRIATUM, *M'Coy*, Syn. Carb. Foss. of Irel., p. 188, 1844.

— MICROPHYLLUM? *Keyserling*, Reise in Petschora, p. 156, tab. i, fig. 2, 1846.

NEMAPHYLLUM MINUS, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d series, vol. iii, p. 17, 1849.

LITHOSTROTION BASALTIFORME and MICROPHYLLUM, *D'Orbigny*, Prodr. de Pal., vol. i, p. 159, 1850.

— — *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Pal., p. 441, 1851.

NEMATOPHYLLUM MINUS, *M'Coy*, Brit. Palæoz. Foss., p. 99, pl. iii B, fig. 3, 1851.

STYLASTREA BASALTIFORMIS, *M'Coy*, *ibid.*, p. 107.

Corallum composite, astreiform. Corallites prismatic, and completely united by their walls. *Calices* very unequal in size. A horizontal section shows that the outer walls are very thin and distinct, and that the existence of the inner walls is indicated only by the limit of the vesicular dissepiments which occupy the exterior zone of the interseptal loculi. Columella small and compressed, but slightly inflated in the middle. *Septa* rather closely set (40 or 50), very thin, delicately flexuous, and varying somewhat in size alternately; the largest only extend near to the columella. Great diagonal of the calices 6 or 8 lines; diameter of the zone occupied by the inner wall, $2\frac{1}{2}$ or 3 lines.

The British specimens here described were found at Bristol, Norfolk, and Kendal. Professor Phillips mentions the existence of the same species at Ribble Head, Moughton Scar, Hesket, Newmarket, and Wrekin; and Colonel Portlock, at Desertmartin, Derry, and

¹ See 'Pol. Foss. des Terr. Palæoz.,' p. 432.

Derryloran, in Ireland. According to M. Keyserling, it is also met with in Petschora. Specimens are in the collections of the Bristol, Cambridge, and Paris Museums, of Professor Phillips of York, &c.

The name of *Lithostrotion* was introduced almost a century ago by Luid (1760), and applied to a fossil Coral, which must be either the above-described species, or a species very nearly allied to it, and presenting the same generical characters.

Luid's designation was more recently extended by Fleming to a generical division characterised by that Zoologist, in the following terms, "Corals of aggregate prismatical parallel tubes, with simple stellar discs," ('British Animals,' p. 508.) The genus *Lithostrotion*, thus established in 1828, contained four species, the first of which was Luid's original *Lithostrotion*, the species No. 4 (*L. marginatum*, Flem.), although too imperfectly characterised to be determinable, evidently belongs to the same generical division, but the species No. 3 (*L. oblongum*), differs from the two preceding ones, and belongs to our genus *Isastrea*, and the species No. 2 (*L. floriforme*), is referable to neither of these forms, and must be placed in a distinct generical division. It is to this last-mentioned genus, (designated recently by Professor M'Coy, under the name of *Lonsdaleia*,) that Mr. Lonsdale applied the generical name of *Lithostrotion*, which, according to the rules generally followed in zoological nomenclature, evidently belongs to the first, that is to say to the group formed by Fleming with Luid's *Lithostrotion* and the allied species.

Goldfuss was not acquainted with any well-characterised *Lithostrotion*, and referred to his genus *Columnaria*, (the typical form of which is *C. alveolata*,) an almost undeterminable fossil, which he called *C. laevis*,¹ and which resembles Luid's *Lithostrotion* by its generical features. M. Dana, in his elaborate work on Zoophytes, published in 1846, very judiciously separates these last-mentioned corals from those which are in reality the typical *Columnaria* of Goldfuss, and which he refers to a new genus, proposed by Mr. Hall, under the name of *Favistella*; he was thus led to apply the name of *Columnaria* to Luid's *Lithostrotion* and to the allied species, that is to say to the genus *Lithostrotion* of Fleming, which must, however, remain distinct from the genus *Columnaria*, of Goldfuss, established essentially for the well-characterised fossil described by the German Palæontologist under the name of *C. alveolata*.

Professor M'Coy had adopted the natural group designated by Fleming under the name of *Lithostrotion*, and by M. Dana under that of *Columnaria*, but has given to it the new name *Nemaphyllum*.

In our opinion the limits of the natural group, so well represented by Luid's *Lithostrotion*, ought not to be restricted to the corals which constitute compact masses, in consequence of the complete lateral coalescence of the corallites, but should also comprise those which, having the same structure and the same mode of multiplication, are not so closely set and form fasciculate aggregations. Sometimes the two forms are met with not

¹ Petref. Germ., tab. xxiv, fig. 8.

only in different specimens of the same species, but even in different parts of the same specimen. The genus *Axinura*, established in 1843 by Count Castelnau for these fasciculate *Lithostrotions*, or the division to which Professor Phillips had previously applied Schweigger's generical name *Lithodendron*, and Professor M'Coy has more recently called *Siphonodendron*, must consequently be abandoned. The genus *Acrocyathus* of M. D'Orbigny is identical with M. Castelnau's genus *Axinura*, and therefore is our system of classification united to Fleming's *Lithostrotion*.

In most species of this group the multiplication of corallites evidently takes place by gemmation, but the young individual which thus shoots from the side of the parent corallites is sometimes produced very near the calicular margin; and, in some of these cases, rising up almost perpendicularly, makes the parent corallite deviate slightly from its primitive direction, and may at first sight be mistaken for an instance of fissiparous reproduction; but the calice never showing signs of incipient division attendant on fissiparity, the appearance of a young corallite thus placed at the side of an adult one, and compressing its calice, is not sufficient to authorise us to admit the existence of that mode of multiplication. Mr. Lonsdale admits that some corals, otherwise resembling *Lithostrotion*, are in reality fissiparous, and it is on that ground that he has established the genera *Stylastræa* and *Diphyphyllum*¹ which differ only from each other in being aggregate, and consequently astreiform, or free laterally and fasciculate; but the arguments which that distinguished Palæontologist makes use of in favour of this opinion, do not appear conclusive, and we therefore do not see sufficient reason for separating these genera from the ordinary *Lithostrotion*. It is also on the presumed fissiparous mode of reproduction that Professor M'Coy has separated from the latter (which, as has already been stated, he calls *Nemaphyllum*,) the fossils that constitute his new genus *Stylaxis*,² and differ from the *Stylastræa* of Mr. Lonsdale, by the existence of a *Columella*, whereas that organ is not seen in the latter; but its absence is probably only accidental, and due to the process of fossilisation, as is often evidently the case in common *Lithostrotions*. Till the alleged difference in the mode of multiplication be more satisfactorily demonstrated, we therefore deem it advisable not to separate *Stylaxis* from the old genus *Lithostrotion*, in which we also leave, as above stated, *Axinura*, *Stylastræa*, and *Diphyphyllum*.

L. basaltiforme differs from the other astreiform *Lithostrotions* by its numerous and thin septa. It is distinguished from *L. Portlocki*³ and *L. M'Coyanum*⁴ by the large size of its calices. In *L. ensifer*⁵ the columella is more prominent, the septa thicker, and the walls very slightly developed. *L. aranea*⁶ is closer allied to the above-described species, but differs from it by its septa, which are not so closely set and more flexuous, and by its columella being stouter.

¹ In Murchison, Verneuil, and Keyserling, *Russia and Ural*, vol. i, p. 621, 1845.

² *Ann. of Nat. Hist.*, vol. iii, p. 119, 1849.

³ See tab. xlii, fig. 1.

⁴ *Ib.*, fig. 2.

⁵ See tab. xxxviii, fig. 2.

⁶ See tab. xxxix, fig. 1.

2. LITHOSTROTION ENSIFER. Tab. XXXVIII, figs. 2, 2a.

LITHOSTROTION ENSIFER, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 442, 1851.

Corallum massive, with a flat or sub-convex surface. *Corallites* separated only by a very thin epithecal wall, which in some places is scarcely visible. *Calices* polygonal, often ill-circumscribed, almost flat towards their circumference, and presenting, in their centre, a shallow fossula. *Columella* stout, compressed, and very prominent. Principal *septa* about 30 in number, thin, nearly straight, somewhat unequal alternately; some rudimentary ones. Diameter of the corallites 4 or 5 lines.

From Clifton, (Bristol Museum.) In this fossil the columella is more prominent than in any other species of the same genus, and the walls much thinner; by the mode of coalescence of the corallites it bears some resemblance to the genus *Phillipsastræa*, in which the walls disappear completely.

3. LITHOSTROTION ARANEA. Tab. XXXIX, figs. 1, 1a.

ASTREA HEXAGONA, var. MINOR? *Portlock*, Rep. on Londonderry, p. 332, pl. xxiii, fig. 2, 1843.

ASTREA ARANEA, *M'Coy*, Syn. Carb. Foss. of Irel., p. 187, 1844.

NEMAPHYLLUM ARANEA, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d series, vol. iii, p. 135, 1849.

LASMOCYATHUS ARANEA, *D'Orbigny*, Prod. de Palæont., vol. i, p. 160, 1850.

LITHOSTROTION ARANEA, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 443, 1851.

Corallum massive. Corallites irregularly polygonal, some of their sides being sometimes curved, whilst most of them are straight. Inner wall rather distinct. *Columella* compressed; its transverse section fusiform. *Septal radii* very thin, but well developed, and slightly flexuous; 22 or 24 principal ones, extending almost to the columella; an equal number of smaller ones that do not reach to the inner wall. Great diameter of the *Calices* about 6 lines; that of the inner wall about half. Dissepiments of the exterior zone very numerous, and forming small, closely set vesicles. *Tabulæ* appearing to be numerous, and much raised towards the centre by the *Columella*.

Found at Armagh, Ireland; the specimen represented in this Monograph belongs to the collection of M. de Verneuil.

The fossil which Col. Portlock considers as a small variety of the *Astrea hexagona* belongs probably to this species; it was found in Ireland.

L. aranea much resembles *L. basaltiforme*;¹ it differs from it by its columella being stouter, its septa less numerous and straighter, and its endotheca less condensed.

4. LITHOSTROTION PORTLOCKI. Tab. XLII, figs. 1, 1a, 1b, 1c, 1d, 1e, 1f, 1g.

ASTREA IRREGULARIS, *Portlock*, Rep. on the Geol. of Londonderry, p. 333, pl. xxiii, figs. 3, 4, 1843. (Not *DeFrance*.)

— — *M'Coy*, Syn. of the Carb. Foss. of Ireland, p. 187, 1844.

ASTREA PORTLOCKI, *Bronn*, Index Palæont., p. 128, 1848.

NEMAPHYLLUM CLISIOIDES, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d series, vol. iii, p. 18, 1849.

LITHOSTROTION PORTLOCKI, *Milne Edwards* and *Jules Haime*, Polyp. Foss. des Terr. Palæoz., p. 443, 1851.

NEMATOPHYLLUM CLISIOIDES, *M'Coy*, Brit. Palæoz. Foss., p. 98, pl. iii B, fig. 2, 1851.

Corallum astreiform. Corallites somewhat unequal in size, prismatic, and completely united by their exterior walls, which are thin, but very distinct. Inner wall scarcely visible in some of the calices. *Septa* (22 to 36), very unequally developed alternately, not closely set, extremely thin, and slightly flexuous; the principal ones extending almost to the *Columella*, which is large, slightly compressed, and prominent. A vertical section shows, that in the exterior zone of the corallites the vesicular dissepiments form 2 or 3 longitudinal series, and are much inclined inwardly, and that the *tabulæ* are well developed, much raised in the centre, and somewhat divided exteriorly. Great diagonal of the corallites 3 or 4 lines.

Found at Bristol, Graigbenayth, Wellington, Corwen, in Derbyshire; and, according to Col. Portlock, at Kildress and at Kesh, in Ireland.

Specimens are in the collections of the Museum of Practical Geology, of Cambridge, of Paris, and of M. de Verneuil.

This species differs from *L. aranea*,² and from *L. basaltiforme*,³ by the smaller size of the corallites, by its septa being stouter and less numerous, and its columella being more developed. It differs from *L. ensifer*⁴ by the greater development of its walls and from *L. M'Coyanum*⁵ by its calices being smaller, and more unequal in size, and its septa less numerous.

¹ See tab. xxxviii, fig. 3.

² See tab. xxxix, fig. 1.

³ See tab. xxxviii, fig. 3.

⁴ See tab. xxxviii, fig. 2.

⁵ See tab. xlii, fig. 2.

5. LITHOSTROTION M'COYANUM. Tab. XLII, figs. 2, 2a, 2b.

LITHOSTROTION M'COYANUM, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 444, 1851.

This fossil much resembles *L. Portlocki*, but the corallites are smaller and much more unequally developed; its inner walls are more distinct, and the septa less numerous, (20 or 24,) somewhat thicker, and less unequal in size alternately; they form a prominent circle round the columella, which is also prominent. Diagonal of the large individuals $1\frac{1}{2}$ line, rarely 2 lines.

Found at Oswestry and Matlock, Derbyshire. Specimens are in the collection of the Museum of Practical Geology, of Mr. Bowerbank, and of the Paris Museum.

6. LITHOSTROTION (?) CONCINNUM.

DIPHYPHYLLUM CONCINNUM, *Lonsdale*, in *Murch.*, *Vern.*, *Keys.*, *Russ.* and *Ural*, vol. i, p. 624, pl. A, fig. 4, 1845.

— LATISEPTATUM, *M'Coy*, *Ann. and Mag. of Nat. Hist.*, 2d ser., vol. iii, p. 8, 1849.

LITHOSTROTION (?) CONCINNUM, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 446, 1851.

DIPHYPHYLLUM LATESEPTATUM, *M'Coy*, *Brit. Palæoz. Foss.*, p. 88, pl. iii, fig. 10, 1851.

Corallites elongate, cylindrical, presenting slight circular growth swellings, and surrounded with a thin epitheca. Inner walls rather distinct. Principal septa 32 in number, very thin, and alternating with an equal number of small ones. *Tabulæ* well developed, smooth towards the centre, the exterior zone occupied by oblique, slightly vesicular dissepiments. Diameter from 3 to 5 lines.

Found at Corwen and in the Oural Mountains. Specimens are in the collection of the Cambridge Museum, and of M. de Verneuil.

All the fossils of this species that we have examined were in a bad state of preservation, and the genus *Diphyphyllum*, established for them by Mr. Lonsdale, does not appear to us sufficiently characterised, for it differs from *Lithostrotion* only by the absence of the columella, and we have much reason to think that the non-existence of that organ is here merely accidental, and due to the process of fossilisation. The considerations which induced Mr. Lonsdale to form this new generic division were founded on the supposed fissiparous mode of multiplication of these corals; but after close examination of their structure we are fully convinced that they are not in reality fissiparous, and that the appearance, which at first sight may be taken for a fissiparous division of the calice, is due to the rapid lateral coalescence of the young individual produced by gemmiparity and the parent corallite.

7. LITHOSTROTION (?) SEPTOSUM.

NEMAPHYLLUM SEPTOSUM, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d ser., vol. iii, p. 19, 1849.

LITHOSTROTION SEPTOSUM, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 444, 1851.

“*Corallum* of long, inseparable, slightly diverging, five or six-angled tubes, with an average diameter of five lines. *Vertical section*: axis straight, thin, flat, three fourths of a line wide; inner area composed of large, rather distant, slightly arched plates, each of which generally extends across the entire area, so that one lengthened cell, (rarely more,) reaches from one side to the other of this area, having the axis in the middle; outer area broad, of numerous, minute, much arched, vesicular plates, inclining obliquely upwards and outwards, about four of the little cells in the oblique line from the inner area to the outer wall. *Transverse rough fracture* showing the inner area to be composed of slightly conical or cup-shaped plates, their diameter equal to that of the area, and pierced in the centre by the flat persistent axis. *Polished transverse section*, radiating lamellæ forty-eight, thin, twenty-four of which reach the centre, while the intervening ones are nearly marginal, not reaching half way to the inner zone; interlamellar vesicular plates very numerous and delicate in the outer zone, apparently absent in the inner zone.

“Very common in the carboniferous limestone of Tullyard, Armagh, Ireland.” (*M'Coy*, loc. cit.)

8. LITHOSTROTION DECIPIENS.

NEMAPHYLLUM DECIPIENS, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d ser., vol. iii, p. 18, 1849.

LITHOSTROTION DECIPIENS, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Pal., p. 441, 1851.

NEMAPHYLLUM DECIPIENS, *Ibid.*, Brit. Palæoz. Foss., p. 99, 1851.

According to Professor M'Coy, this coral is of the same size as *L. irregulare*, from which it differs by its septa being straighter and its exterior vesicles much more oblique. Found in the carboniferous limestone of Derbyshire.

9. LITHOSTROTION JUNCEUM. Tab. XL, figs. 1, 1a, 1b.

JUNCEI LAPIDEI, *David Ure*, Hist. of Rutherglen, p. 337, tab. xix, fig. 12, 1793.

CARYOPHYLLIA JUNCEA, *Fleming*, Brit. Anim., p. 509, 1828.

— — *S. Woodward*, Syn. Table of Brit. Org. Rem., p. 6, 1830.

LITHODENDRON JUNCEUM, *Keferstein*, Nat. der Erdkorp., vol. ii, p. 785, 1834.

— SEXDECIMALE, *Phillips*, Geol. of Yorkshire, vol. ii, p. 202, pl. ii, figs. 11, 12, 13, 1836.

CARYOPHYLLIA SEXDECIMALIS, *De Koninck*, Foss. des Terr. Carb. de Belg., p. 17, pl. D, fig. 4, 1842.

CLADOCORA SEXDECIMALIS, *Morris*, Cat. of Brit. Foss., p. 33, 1843.

LITHODENDRON COARCTATUM, *Portlock*, Rep. on Londonderry, p. 336, pl. xxii, fig. 5, 1843.

LITHODENDRON SEXDECIMALE and COARCTATUM, *M'Coy*, Syn. Carb. Foss. of Ireland, pp. 188-89, 1844.

CLADOCORA SEXDECIMALIS, *Geinitz*, Grund. der Vert., p. 570, 1845-46.

DIPHYPHYLLUM SEXDECIMALE *D'Orbigny*, Prod. de Pal., vol. i, p. 159, 1850.

LITHOSTROTION JUNCEUM, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 435, 1851.

SIPHONODENDRON SEXDECIMALE, *M'Coy*, Brit. Palæoz. Foss., p. 109, 1851.

Corallum composite, fasciculate. *Corallites* very elongate, cylindrical, straight, or but slightly irregular, strongly bent upwards near their basis, and placed at various distances, but rarely coalescent. *Epitheca* delicately wrinkled transversely. *Columella* rather large, slightly compressed. Principal *septa* 16 or 18, alternating with an equal number of smaller ones, and extending very near to the columella. Diameter of the corallites about $1\frac{1}{2}$ line.

Found at Mold, Wellington, Oswestry, Allendale; according to Professor Phillips, at Kirby Lonsdale, Kettlewell, Penyghent, Aldstone Moor, Veynal; according to D. Ure, at Rutherglen, Lanarek; according to Professor M'Coy, at Kendal, Lowick, and Burdiehouse; and according to Colonel Portlock, in Ireland, at Derryloran and Corkstown. It is met with also at Visé, in Belgium, and in the Oural Mountains.

Specimens are in the collections of the Geological Society, of the Museum of Practical Geology, of Mr. Bowerbank, &c.

10. LITHOSTROTION MARTINI. Tab. XL, figs. 2, 2a, 2b, 2c, 2d, 2e, 2f, 2g.

ERISMATOLITHUS, &c., *William Martin*, Petref. Derb., pl. xvii, 1809.

CARYOPHYLLIA FASCICULATA, *Fleming*, Brit. Anim., p. 509, 1828. (Not *Lamarck*.)

LITHODENDRON FASCICULATUM, *Phillips*, Geol. of Yorkshire, vol. ii, p. 202, pl. ii, figs. 16, 17, 1836.

CARYOPHYLLIA FASCICULATA, *De Koninck*, Anim. Foss. des Terr. Carb. de Belg., p. 17, pl. D, fig. 5, and pl. G, fig. 9, 1842.

LITHODENDRON CÆSPITOSUM, *M'Coy*, Syn. Carb. Foss. of Ireland, p. 188, 1844. (Not *Goldfuss*.)

LITHODENDRON FASCICULATUM, *Lonsdale*, in *Murch.*, Vern., et *Keys.*, Russ. and Ur., vol. i, p. 600, 1845.

CLADOCORA FASCICULATA, *Geinitz*, Grundr. der Verst., p. 570, 1845-46.

DIPHYPHYLLUM FASCICULATUM, *D'Orbigny*, Prod. de Palæont., vol. i, p. 159, 1850.

LITHOSTROTION MARTINI, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 436, 1851.

SIPHONODENDRON FASCICULATUM, *M'Coy*, Brit. Palæoz. Foss., p. 108, 1851.

Corallum fasciculate. *Corallites* very tall, cylindrical, slightly flexuous, and often coalescent. *Epitheca* thin, and not hiding the delicate, straight, flat striæ, formed by the closely set costæ. *Calices* circular. *Columella* rather thin, and very much compressed. *Septa* extremely thin, straight, or but slightly curved, and rather closely set; 26 principal ones, reaching almost to the outer of the tabulæ, and 26 small ones that do not extend

far from the wall. *Tabulæ* placed at about half a line apart, almost horizontal in the centre, but becoming almost erect near the edge. Diameter of the *Calices* 4 or 5 lines; diameter of the smooth portion of the *tabulæ* 1 line.

Found at Rugley, Oswestry, Corwen; according to Prof. Phillips, at Ribblesdale, Teesdale, Ashfell, Bristol, and in Northumberland; according to Martin, at Bakewell, Winster, and Castleton; and, according to Prof. M'Coy, in Ireland. It is also met with at Visé in Belgium. Specimens are in the collections of the Museum of Practical Geology, of Prof. Phillips, Mr. Bowerbank, Mr. Stokes, the Paris Museum, &c.

L. Martini differs from *L. junceum*,¹ *L. irregulare*,² *L. antiquum*,³ *L. harmonites*,⁴ and *L. Stokesi*,⁵ by the large size of its corallites, and their numerous septa. It is on the contrary smaller than *L. affine*,⁶ which is multiradiate, and has numerous small and regular vesicles in the interseptal loculi. *L. Phillipsi*⁷ is the species nearest allied to the above-described fossil, but differs from it by the columella being less compressed, and by the frequent coalescence of the corallites. The other species of this genus, such as *L. aranea*,⁸ *L. ensifer*,⁹ *L. basaltiforme*,¹⁰ *L. Portlocki*,¹¹ and *L. M'Coyanum*,¹² are easily distinguished from *L. Martini* by the massive, astreiform structure of their compound corallum.

11. LITHOSTROTION IRREGULARE. Tab. XLI, figs. 1, 1a, 1b, 1c, 1d, 1e.

SCREW STONE, *Robert Plot*, Nat. Hist. of Staffordshire, p. 195, tab. xii, fig. 5, 1686.

MADREPORA, &c., *Parkinson*, Org. Rem., vol. ii, pl. vi, fig. 8, 1808.

CARYOPHYLLÆA, *Conybeare* and *W. Phillips*, Geol. of England and Wales, p. 359, 1822.

CARYOPHYLLIA FASCICULATA, *De Blainville*, Dict. Sc. Nat., vol. lx, p. 311, 1830. Man. d'Actinol, p. 345. (Not *Lamarek*.)

— — — *Woodward*, Syn. Table of Brit. Org. Rem., p. 6, 1830.

LITHODENDRON IRREGULARE, *John Phillips*, Geol. of Yorkshire, vol. ii, p. 202, pl. ii, figs. 14, 15, 1836.

CLADOCORA IRREGULARIS, *Morris*, Cat. of Brit. Foss., p. 33, 1843.

LITHODENDRON FASCICULATUM, *Portlock*, Rep. on Londonderry, p. 335, 1849. (Not *Phillips*.)

LITHODENDRON IRREGULARE, *Portlock*, Rep. on Londonderry, p. 336, 1849.

LITHODENDRON PAUCIRADIALE, *M'Coy*, Syn. Carb. Foss. of Ireland, p. 189, 1844.

SIPHONODENDRON PAUCIRADIALE, *M'Coy*, Ann. of Nat. Hist., 2d series, vol. iii, p. 139, 1849.

¹ See tab. xl, fig. 1.

² See tab. xli, fig. 1.

³ *Lithodendron cespitosum*, Goldfuss, tab. iii, fig. 4; *Lithostrotion antiquum*, Milne Edwards and Jules Haime, Polyp. Foss. des Terr. Palæoz., p. 439.

⁴ Milne Edwards and J. Haime, op. cit., tab. xv, fig. 1.

⁵ Ibid., tab. xx, fig. 2.

⁶ See tab. xxxix, fig. 2.

⁷ See tab. xxxix, fig. 3.

⁸ See tab. xxxix, fig. 1.

⁹ See tab. xxxviii, fig. 2.

¹⁰ See tab. xxxviii, fig. 3.

¹¹ See tab. xlii, fig. 1.

¹² See tab. xlii, fig. 2.

DIPHYPHYLLUM PAUCIRADIALE, *D'Orbigny*, Prod. de Palæont., vol. i, p. 159, 1850.

DIPHYPHYLLUM IRREGULARE, *D'Orbigny*, Prod. de Paléont., vol. i, p. 159, 1850.

LITHOSTROTION IRREGULARE, *Milne Edwards* and *Jules Haime*, Polyp. Foss. des Terr. Palæoz., p. 436, 1851.

LITHOSTROTION PAUCIRADIALE, *Milne Edwards* and *Jules Haime*, *ibid.*, p. 439.

SIPHONODENDRON AGGREGATUM, *M'Coy*, Brit. Palæoz. Foss., p. 108, 1851.

Corallum fasciculate. Corallites very tall, cylindrical, and flexuous, especially towards their basis, where they are proliferous, and many of their young branches seem to have avorted, and to have become cemented to the neighbouring individuals. *Columella* but slightly compressed. *Septa* extremely thin, and rather widely set; the principal ones (18 in the young corallites, and 24 in the adult,) extending almost to the centre of the Corallite; the intermediate ones coming very near to the principal ones near the *Columella*, and the small ones almost rudimentary. *Tabulæ* placed at about a quarter of a line apart, and presenting only a very small smooth portion. Diameter of the calices about $2\frac{1}{2}$ lines; that of the smooth part of the tabulæ not quite 1 line.

Found at Castleton, Corwen, and Oswestry; according to Professor Phillips, at Bristol, Ashfell, and in Northumberland; according to Col. Portlock, at Martindesert, Desertcreat; and, according to Professor M'Coy, Magheramore and Tobercury. It is also met with in the Oural mountains.

Specimens are in the collections of the Museum of Practical Geology, Professor Phillips, Mr. Bowerbank, the Paris Museum, &c.

In this species the corallites are broader and more lamelliferous than in *L. junceum*,¹ and on the contrary, smaller and not provided with as many septa as in *L. affine*,² *L. Martini*,³ and *L. Phillipsi*.⁴ It is more difficult to distinguish *L. irregulare* from *L. antiquum*,⁵ *L. harmodites*,⁶ and *L. Stokesi*.⁷ The latter differs from it by the existence of mural expansions, which are never met with in the above-described species, and *L. harmodites* differs from it by the existence of connecting tubes, which resemble those of *Syringopora*. *L. antiquum* is most closely allied to it, but its septa are less numerous, although the diameter of the calice be somewhat larger, and its columella is stouter and more compressed.

We are inclined to think that the *Diphyphyllum gracile* of Professor M'Coy⁸ is a specimen of *Lithostrotion irregulare*, in which the Columella has been accidentally destroyed by the process of fossilisation. This Coral was found at Lowick in Northumberland.

¹ See tab. xli, fig. 1.

² See tab. xxxix, fig. 2.

³ See tab. xl, fig. 2.

⁴ See tab. xxxix, fig. 3.

⁵ *Milne Edwards* and *J. Haime*, Polyp. Palæoz., p. 439; *Lithodendron cespitosum*, Goldfuss, Petref. Germ., tab. xiii, fig. 4.

⁶ *Milne Edwards* and *J. Haime*, *op. cit.*, tab. xx, fig. 2.

⁷ *Milne Edwards* and *Jules Haime*, *op. cit.*, tab. xv, fig. 1.

⁸ Ann. and Mag. of Nat. Hist., vol. iii, p. 2; vol. vii, p. 168; and Brit. Palæoz. Foss., p. 88, figs. *d, e, f*.

12. LITHOSTROTION AFFINE. Tab. XXXIX, figs. 2, 2a, 2b.

MADREPORA, *Knorr and Walch*, Rec. des Mon. des Catastr., pl. lxi*, fig. 2, 1775.

— PECTINATA, &c., *Parkinson*, Org. Rem., vol. ii, pl. vi, fig. 5, and perhaps fig. 9, 1808.

ERISMATOLITHUS MADREPORITES (AFFINIS), *William Martin*, Petref. Derb., pl. xxxi, 1809.

CARYOPHYLLIA AFFINIS, *Fleming*, Brit. Anim., p. 509, 1828.

— — *De Blainville*, Dict. Sc. Nat., vol. lx, p. 311, 1830; Man. d'Actin. p. 346.

— — *Woodward*, Syn. Table of Brit. Org. Rem., p. 6, 1830.

LITHODENDRON AFFINE, *Keferstein*, Nat. der Erdk., vol. ii, p. 785, 1834.

— LONGICONICUM and SOCIALE, *Phillips*, Geol. of Yorkshire, vol. ii, p. 203, pl. ii, figs. 18, 19, 1836.

— SOCIALE and LONGICONICUM, *Portlock*, Rep. on Lond., pp. 335-36, 1843.

— AFFINE and SOCIALE, *M'Coy*, Carb. Foss. of Ireland, pp. 188-89, 1844.

DIPHYPHYLLUM LONGICONICUM and SOCIALE, *D'Orbigny*, Prod., vol. i, p. 159, 1850.

LITHOSTROTION AFFINE, *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 437, 1851.

Corallum fasciculate, dendroid. *Corallites* erect, cylindro-turbinate, very tall, giving rise to many young individuals, which bend upwards immediately, often coalescent and cemented together, and covered from top to bottom with a thin slightly wrinkled epitheca. In the parts where the epitheca is worn away, the costæ become visible, and are flat, closely set, and equal in size. *Calice* circular, broad and deep. *Columella* compact, compressed, and projecting in the centre of the calicinal tabulæ in the form of a small crista. *Septa* narrow and closely set; the principal ones almost equal (30 or 32), alternating with almost rudimentary ones, which do not articulate on the surface of the tabulæ, are thin, and appear to be denticulate. *Tabulæ* very closely set, convex towards the centre, but bending upwards towards the circumference, simple, regular, and run through by the columella, to which they are intimately united. The smooth part of their upper surface, on which the septa do not extend, occupies somewhat more than one third of the diameter of the corallum, which is about 5 or 6 lines.

The specimens here described were found at Castleton. Professor Phillips mentions the existence of this species at Kulkeagh mountain, Florencecourt, and Settle; according to Martin, it is met with also at Winster, and, according to Colonel Portlock, at Derry-loran and Kilcronaghan. Specimens are in the collections of Mr. Bowerbank, of the Paris Museum, and of M. de Verneuil.

This species is the largest of all the fasciculate Lithostrotions except *L. canadense*,¹ in which the corallites are sometimes cylindrical and quite free laterally, and at other places prismatic and completely cemented together, and in which, also, the centre of the calice is

¹ Milne Edwards and Jules Haime, Pol. Palæoz., tab. xiii, fig. 1.

conical and the columella small. *L. affine* is remarkable for the turbinate form of the young corallites, the existence of a well-marked septal fossula, and the abundance of the interseptal vesicles. The coexistence of these characters distinguishes it sufficiently from all the other species.

13. LITHOSTROTION PHILLIPSI. Tab. XXXIX, figs. 3, 3a.

LITHODENDRON FASCICULATUM, *Keyserling*, Reise in Petsch., p. 170, pl. iii, fig. 2, 1846.
(Not *Phillips*.)

LITHOSTROTION PHILLIPSI, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 439, 1851.

Corallum fasciculate, much resembling *L. Martini*,¹ but differing from it by the frequent coalescence of the corallites, which unite laterally, so as to form small rows, somewhat as in the *Halysites*. There appears to be about 30 septa. *Columella* somewhat compressed. Diameter of the calices about 4 lines.

Found in Ireland and in Russia. The specimen figured in this Monograph belongs to the collection of Mr. Stokes.

The flexuous form of the corallites, and their mode of partial union by means of longitudinal sutures, distinguish this species from all the other fasciculate *Lithostrotions*.

14. LITHOSTROTION (?) DERBIENSE.

STYLASTREA IRREGULARIS, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d ser., vol. iii, p. 9, 1849.

LITHOSTROTION (?) DERBIENSE, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 445, 1851.

STYLAXIS IRREGULARIS, *M'Coy*, Brit. Palæoz. Foss., p. 101, pl. iii A, fig. 5, 1851.

This fossil is very imperfectly known, having been found only in a very bad state of preservation. The Corallites are irregular and bent in zigzags; the Calices are polygonal; the septæ flexuous, about 30 in number, rather unequal in size alternately. *Tabulæ* broad and almost horizontal; exterior zone accompanied by two or three rows of vesicular dissepiments. Diameter of the corallites 2 lines. Found in the carboniferous limestone of Derbyshire.

15. LITHOSTROTION MAJOR.

STYLAXIS MAJOR, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d series, vol. iii, p. 120, 1849.

— *Milne Edwards* and *Jules Haime*, Polyp. Foss. des Terr. Palæoz., p. 454, 1851.

— *M'Coy*, Brit. Palæoz. Foss., p. 101, pl. iii A, fig. 4, 1851.

¹ See tab. xl, fig. 2.

"Tubes averaging 6 lines in diameter, mostly hexagonal; external surface coarsely striated longitudinally, and transversely marked with strong curved irregularities of growth, the convexity of the curves upwards; *horizontal section*, 63 slender radiating lamellæ, converging from the walls towards the flat central style or axis, which is about one line in width; one half of the lamellæ reach the centre, the intervening ones reach rather more than half way; outer area exhibiting numerous transverse vesicular plates between the radiating lamellæ.

"*Vertical section*, axis straight, riband-like; inner area broad, of slightly-curved vesicular plates, forming rows of lengthened irregular cells, extending obliquely downwards and outwards from the axis, about three in a row; *outer area* of rows of small, hemispherically-curved plates, including small, rounded cells, extending very obliquely upwards and outwards, about 5 or 6 in each row.

"From the carboniferous limestone of Derbyshire." (M'Coy, *op. cit.*)

16. LITHOSTROTION ARACHNOIDEUM.

NEMAPHYLLUM ARACHNOIDEUM, M'Coy, Ann. and Mag. of Nat. Hist., 2d series, vol. iii, p. 15, figs. A, B, and p. 16, 1849.

STYLAXIS ARACHNOIDEA, Milne Edwards and Jules Haime, Pol. Foss. des Terr. Palæoz., p. 454, 1851.

NEMATOPHYLLUM ARACHNOIDEUM, M'Coy, Brit. Palæoz. Foss., p. 97, pl. iii A, fig. 6, 1851.

"*Stars*, with from four to seven angles, and averaging from 6 to 9 lines in diameter; *axis* very thin, 1 line wide; *vertical section*, inner vesicular area wider than the outer of little arched plates, inclining slightly downwards from the axis; it takes about two (rarely one) of those plates to reach from the axis to the extent of this area, or two irregularly elongate, unequal cells in a slightly oblique line, from the axis to the wall of the inner area; outer area separated from the inner by a sharp, distinct line on each side, and composed of much smaller and more highly curved vesicular plates, so that there are from 5 to 7 small, nearly equal, rounded cells, extending in a line obliquely upwards and outwards, from the inner area to the outer walls of the tube; *horizontal section*, boundary or divisional walls thin, stars radiated with from 50 to 55 very thin lamellæ, of equal thickness, but alternately long and short, the long reaching to the centre, the short barely entering the edge of the inner area; *weathered surface*, stars flattened, separated by a depressed line; *inner area* forming a gentle convex, oval, or circular boss, with the axis forming a short impressed line in the middle; the radiating lamellæ exhibit numerous delicate, curved, interstitial plates in the outer area, but none in the inner area.

"Forms large masses in the carboniferous limestone of Derbyshire." (M'Coy, *op. cit.*)

17. LITHOSTROTION FLEMINGI.

- STYLAXIS FLEMINGII, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d series, vol. iii, p. 121, 1849.
 — — *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 494, 1851.
 — — *M'Coy*, Brit. Palæoz. Foss., p. 160, pl. iii A, fig. 3, 1851.

“*Corallum* of very long, prismatic, generally hexagonal, easily separable tubes, averaging 3 lines in diameter; outer surface strongly striated longitudinally, and marked with direct transverse rugosities of growth; bipartite division of the columns frequent;¹ *vertical section*, exhibiting the thin flat axis, surrounded by an inner zone of small, slightly curved, interstitial plates, inclining downwards and outwards from the axis, forming on each side a row of nearly simple oblique cells; *outer zone* of small, vesicular, much-curved plates, inclined in an opposite direction, or upwards and outwards, four or five in a row; *horizontal section*, axis thin, half a line wide, surrounded by about 43 thin, radiating lamellæ, from the walls, half of which only reach half way; numerous small, thin, transverse, connecting plates between the lamellæ in the outer zone.

“Common in the carboniferous limestone of Derbyshire.” (*M'Coy*, *op. cit.*)

6. Genus PHILLIPSTRÆA, (p. lxx.)

1. PHILLIPSTRÆA RADIATA. Tab. XXXVII, figs. 2, 2a.

- ERISMATOLITHUS TUBIPORITES (*radiatus*), *W. Martin*, Petrif. Derb., pl. xviii, 1809.
 TUBIPORA RADIATA, *S. Woodward*, Syn. Table of Brit. Org. Rem., p. 5, 1830.
 ASTREA HENNAHII (*pars*), *Phillips*, Palæoz. Foss., pl. vii, fig. 15 D, (*Cæt. excl.*), 1841.
 (Not *Lonsdale*).
 SARCINULA PLACENTA and PHILLIPSII, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d series, vol. iii, p. 124, 125, 1849.
 PHILLIPSTRÆA HENNAHII (*pars*), *D'Orbigny*, Prod. de Paléont., vol. i, p. 107, 1850.
 PHILLIPSTRÆA RADIATA, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 448, 1851.
 SARCINULA PHILLIPSII and PLACENTA, *M'Coy*, Brit. Palæoz. Foss., p. 110, pl. iii B, fig. 9, 1851.

Corallum massive, astreiform, with a flat surface. *Calices* irregularly placed; their edges very slightly prominent, and their central fossula rather deep. *Columella* slender, compressed, and in general not very distinct. Septo-costal radii almost completely confluent exteriorly; 24 or 30 in number, very thin, and becoming alternately unequal in size near the walls, where some of them terminate. Diameter of the Calices about

¹ We have here above explained how this appearance may be produced by submarginal gemmation. (See p. 192.)

1½ line; depth one half the diameter. A vertical section shows that the walls are somewhat indistinct; the visceral chambers are closed by large, concave, somewhat irregular *tabulæ*, and that the vesicles occupying the intercostal loculi are small, irregular, twice as high as they are broad, and arranged pretty regularly in horizontal rows.

Found in Derbyshire, and at Corwen; and, according to Martin, at Winster. Specimens are in the Collections of the Museums of Practical Geology, of Cambridge and of Paris.

This species differs from *P. Verneuxi*,¹ by its septo-costal radii being very slender, and somewhat unequal, and it appears to differ from *P. tuberosa*² by its calices not having prominent edges, and by the horizontal arrangement of the series of interseptal vesicles, which, in this last-mentioned fossil, appear to form concave or flexuous rows. We are, however, not quite sure that these differences may not be accidental.

2. PHILLIPASTRÆA TUBEROSA.

SARCINULA TUBEROSA, M'Coy, Ann. and Mag. of Nat. Hist., 2d series, vol. iii, p. 124, 1849.

PHILLIPASTRÆA TUBEROSA, Milne Edwards and Jules Haime, Pol. Foss. des Terr. Palæoz., p. 449, 1851.

SARCINULA TUBEROSA, M'Coy, Brit. Palæoz. Foss., p. 110, pl. iii B, fig. 8, 1851.

Calices prominent, mammiliferous, and in general placed very distant from each other, but irregularly so. Septo-costal radii (32) extremely thin, confluent, and flexuous externally, but not strongly geniculated. Intercostal dissepiments subpolygonal, twice as broad as they are high, somewhat unequal, and appearing to form concave or flexuous rows. Diameter of the Calices, scarcely 2 lines.

From the carboniferous limestone of Derbyshire. Specimen in the Cambridge Museum.

Sub-Family AXOPHYLLINÆ,³

1. Genus PETALAXIS, (p. lxxi.⁴)

PETALAXIS PORTLOCKI. Tab. XXXVIII, figs. 4, 4a.

STYLAXIS PORTLOCKI, Milne Edwards and Jules Haime, Pol. Foss. des Terr. Palæoz., p. 453. 1851.

¹ Milne Edwards and Jules Haime, Polyp. Palæoz., p. 447, tab. 10, fig. 5.

² *Sarcinula tuberosa*, M'Coy, Ann. and Mag. of Nat. Hist., 2d series, vol. iii, p. 124.

³ Milne Edwards and Jules Haime, Pol. Foss. des Terr. Palæoz., p. 452.

⁴ Under the name of *Nematophyllum*.

Corallum astreiform; Corallites prismatic; principal septa extremely slender, broader, and less numerous than in *P. M'Coyana*.¹

In a former work we referred this species to the *Genus* STYLAXIS of Professor M'Coy, because, from the inspection of the woodcuts given by that author in the 'Annals of Natural History,' we had been led to suppose that *Stylaxis* differed from *Lithostrotion*, by the existence of a well-developed septal apparatus, and a lamellar columella; but the figures recently published by the same geologist prove that we were mistaken, and that the *Genus* STYLAXIS of Professor M'Coy does not in reality differ from *Lithostrotion*; we have, therefore, been obliged to abandon that name, and to establish here a new generical division (*Petalaxis*), for the fossils which we formerly named *Stylaxis M'Coyana*² and *S. Portlocki*.

2. *Genus* AXOPHYLLUM, (p. lxxii.)

AXOPHYLLUM RADICATUM, *Milne Edwards and Jules Haime*, Pol. des Terr. Palæoz., p. 456; tab. xii, fig. 1, 1851.

We are inclined to think that the fossil coral, found by Col. Portlock in the carboniferous limestone at Stewartston, Tyrone,³ and referred by that Geologist to the *Turbinolia verrucosa* of Hisinger (which is an Omphyma of the Silurian formation), belongs to this species, or is closely allied to it.

3. *Genus* LONSDALEIA, (p. lxxii.⁴)

1. LONSDALEIA FLORIFORMIS. Tab. XLIII, figs. 1, 1a, 1b, 1c, 1d, 1e, 2, 2a.

Stone found in Wales (?), *Llwyd*, Phil. Trans., vol. xxi, p. 187, No. 252, figs. 3, 4, 1700.
Very rough figures.

ERISMATOLITHUS MADREPORITES (FLORIFORMIS), *William Martin*, Petref. Derby., tab. xliii, figs. 3, 4, and tab. xlv, fig. 5, 1809.

STYLINA COMPOUND, *Parkinson*, Introd. to the Study of Foss. Org. Rem., pl. x, fig. 5, 1822.
Good.

ASTREA FLORIDA, *Defrance*, Dict. Sc. Nat., vol. xlii, p. 383, 1826.

LITHOSTROTION FLORIFORME, *Fleming*, Brit. Anim., p. 508, 1828.

— — *S. Woodward*, Table of Brit. Org. Rem., p. 5, 1830.

COLUMNARIA FLORIFORMIS, *De Blainville*, Dict. Sc. Nat., vol. lx, p. 316, 1830; Man., p. 350.

CYATHOPHYLLUM FLORIFORME, *Phillips*, Geol. of York, vol. ii, p. 202, 1836.

¹ *Milne Edwards and Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 453, pl. xii, fig. 5.

² Polyp. Palæoz., p. 453, tab. xii, fig. 5.

³ Report on Londonderry, p. 331.

⁴ Under the name of *Lithostrotion*.

ASTREA EMARCIDA, *Fischer*, *Oryct. de Moscou*, p. 154, pl. xxxi, fig. 5, 1837.

— PENTAGONA (?), *Ibid.*, p. 154.

— MAMILLARIS, *Fischer*, *ibid.*, p. 154, pl. xxxi, figs. 2, 3.

CYATHOPHYLLUM EXPANSUM, *Ibid.*, p. 155, pl. xxxi, fig. 1, 1837. (Named *Astrea expansa*, in the first edition, 1830.)

LITHOSTROTION MAMILLARE, and ASTROIDES, *Lonsdale*, in *Murch.*, *Vern.*, *Keys.*, *Russ.* and *Ur.*, vol. i, pp. 606, 607, figs. *a*, *b*, *c*, 1845.

CYATHOPHYLLUM ASTREA, *Bronn*, *Ind. Palæont.*, p. 367, 1848.

STROMBODES CONAXIS, *M'Coy*, *Ann. and Mag. of Nat. Hist.*, 2d ser., vol. iii, p. 10, 1849.

LITHOSTROTION MAMILLARE, *D'Orbigny*, *Prodr. de Pal.*, vol. i, p. 159, 1850.

LONSDALIA FLORIFORMIS, *Milne Edwards* and *Jules Haime*, *Pol. Foss. des Terr. Palæoz.*, p. 458, 1851.

STROMBODES CONAXIS, *M'Coy*, *Brit. Palæoz. Foss.*, p. 102, pl. 3 B, fig. 4, 1851.

— FLORIFORME, *Ibid.*, p. 103.

Corallum astreiform. *Corallites* prismatic, very unequal in size, and separated by well-developed exothecal walls. *Calices* rather deep. *Columella* stout, very prominent, compressed at its end, which assumes the form of a small crest, and presents, on its lateral sides, ascendant curved ridges. Twenty-four principal *septa*, which are thin, narrow; form in general, a slight annular protuberance round the central fossula, and alternate with an equal number of smaller *septa*. The costal prolongation of the septal radii pretty well marked on the exterior zone. Diagonal of the large corallites 8 or 10 lines, sometimes half as much more; diameter of the inner walls from 3 to 5 lines.

A vertical section shows that the interseptal dissepiments are very closely set, (about half a line apart,) and almost horizontal, or sloping slightly upwards towards the columella; the inner walls but little developed, and the vesicles of the exterior zone very unequal in size and very oblique inwards. A horizontal section shows that four or five of these vesicles are placed between the outer and inner walls, and that the regular radiate laminæ pass through the concentric laminæ of the columella, which is dense in the axis of the corallite.

Found at Bristol, Lilleshall, Mold, Oswestry, Whitehaven, Maryport, (Cumberland,) according to Professor Phillips, at Bolland, and according to Professor M'Coy, at Bakewell, in Derbyshire. It is also met with in the carboniferous formation in Russia. Specimens are in the collections of the Geological Society, of the Museum of Practical Geology, of the Bristol and Cambridge Museums, of Mr. Bowerbank, of Professor Phillips, of the Paris Museum, &c.

The generic division, designated here under the name of *Lonsdaleia*, has been considered by Mr. Lonsdale and by many of our contemporaries as being the genus *Lithostrotion*, of Fleming; but the figure in Llywd's work, quoted by that geologist, can admit of no uncertainty as to the real signification of the latter group, which, as we have already said, was evidently intended to receive the coral described above under that name. Professor M'Coy, who does not adopt Fleming's genus, *Lithostrotion*, applies to the *Lithostrotion* of

Mr. Lonsdale the name of *Strombodes*; the zoological value of which had been previously fixed in a manner quite different by Schweigger and by Goldfuss, and he has at the same time given the name of *Lonsdaleia* to a new division comprising the corals which do not differ from his ill-denominated *Strombodes* by their structure, but are only fasciculate and not coalescent. This latter distinction does not appear to us advisable, and in order not to augment without necessity the number of generic names applied to the same objects, we have employed the name of *Lonsdaleia* in a wider acceptation, and made it equivalent to the *Lithostrotion* of Mr. Lonsdale, and to *Lonsdaleia* and *Strombodes* of Professor M'Coy.

Lonsdaleia floriformis is easily distinguished from *L. rugosa*¹ and *L. duplicata*² by the disposition of its corallites to coalesce completely. It differs from *L. Bronni*³ by the unequal development of its septa, and from *L. papillata*⁴ by its columella being larger and more prominent, and by the part of the corallites situated near the exterior wall not being entirely vesicular.

2. LONSDALEIA PAPILLATA.

CYATHOPHYLLUM PAPILLATUM, *Fischer*, Oryct. de Moscou, p. 155, pl. xxxi, fig. 4, 1837.

COLUMNARIA TROOSTI, *Castelnau*, Ter. Sil. de l'Amer. du Nord., pl. xix, fig. 2, 1843.

LITHOSTROTION FLORIFORME, *Lonsdale*, in Murch. Vern. Keys. Russ. and Ur., vol. i, p. 609, figs. a, b, c, 1845. (Not *Fleming*.)

— EMARCIATUM, *Ibid.*, p. 603, figs. a, f.

— FLORIFORME, *Keyserling*, Reise in Petschora, p. 154, tab. i, fig. 1, 1846. (Synonymis exclusis.)

STROMBODES EMARCIATUM, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d ser., vol. iii, p. 136, 1849.

LITHOSTROTION FLORIFORME, *D'Orbigny*, Prod. de Pal., vol. i, p. 159, 1850.

LONSDALIA PAPILLATA, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 460, pl. xi, fig. 2, 1851.

STROMBODES EMARCIATUM, *M'Coy*, Brit. Palæoz. Foss., p. 103, 1851.

Corallum massive; upper end of the corallites polygonal, often tetragonal, with simple, thin edges; exterior zone almost flat; calicinal fossula rather large and deep. *Columella* not very prominent, somewhat attenuated upwards, and bearing laterally subvertical, oblique, slightly curved ridges. Principal *septa* 22 or 24 in number, thin, not extending quite to the columella, and alternating with an equal number of small ones. Great diagonal of the corallites, in general, about 8 lines. Diameter of the walls $3\frac{1}{2}$ or 4 lines.

A vertical section shows that the inner walls are slender, but very distinct, and formed by the inner edge of the vesicles of the exterior zone, which are somewhat unequal, strongly

¹ See tab. xxxviii, fig. 5.

² *Lonsdalia crassiconus*, *M'Coy*, Ann. and Mag. of Nat. Hist., s. 2, vol. iii, p. 12.

³ *Milne Edwards* and *Jules Haime*, Polyp. Foss. des Terr. Palæoz., p. 459, tab. ii, fig. 1.

⁴ *Ibid.*, p. 460, tab. ii, fig. 2.

arched, slightly inclined inwards, broader than high, and bear on their surface small rudiments of costal prolongations. A horizontal section usually passes through three of these vesicles in the space comprised between the two walls, and shows that the dissepiments in the inner zone are simple, almost horizontal, or slightly arched, and placed at about half a line apart.

Found in Derbyshire, in Russia, and in North America. Specimens are in the collection of M. de Verneuil.

This species much resembles *L. floriformis*,¹ but differs from it by its columella being less stout and less prominent, and by its rudimentary costal radii. It differs from *L. Bronni*² by the unequal development of its septa, and from *L. rugosa*³ and *L. duplicata*⁴ by the fasciculate forms of these two latter species.

3. LONSDALEIA RUGOSA. Tab. XXXVIII, fig. 5.

LONSDALIA RUGOSA, M'Coy, Ann. and Mag. of Nat. Hist., 2d series, vol. iii, p. 13, 1849.

— — Milne Edwards and Jules Haime, Pol. Foss. des Terr. Palæoz., p. 461, 1851.

— — M'Coy, Brit. Palæoz. Foss., p. 105, pl. iii B, fig. 6, 1851.

Corallites in general free laterally, sub-cylindrical, having very strong circular growth swellings, and covered with a very thick epitheca. *Columella* broad. *Septa* thin, and almost equal, about 10. Diameter of the *Corallites* very variable;—the largest about 8 lines.

Found at Mold and Corwen. Specimens are in the collections of the Museums of Practical Geology, of Cambridge and of Paris.

This species differs from *L. Bronni*,⁵ *L. floriformis*,⁶ and *L. papillata*,⁷ by the tendency of the *Corallites* to remain free laterally; and from *L. duplicata*,⁸ which it resembles in that respect, by the irregular tumefactions of the surface of the walls of the corallites.

¹ See tab. xliii, figs. 1, 2.

² Milne Edwards and Jules Haime, Polyp. des Terr. Palæoz., tab. xi, fig. 1.

³ M'Coy, Brit. Palæoz. Fossils, p. 105.

⁴ *Lonsdalia crassiconus*, M'Coy, Ann. and Mag. of Nat. Hist., 2d ser., vol. iii, p. 12. *Erismatolithus duplicatus*, Martin, Petrif. Derb., pl. xxx.

⁵ Milne Edwards and Jules Haime, Polyp. Palæoz., tab. xi, fig. 1.

⁶ See tab. xliii, figs. 1, 2.

⁷ Milne Edwards and Jules Haime, op. cit., tab. xi, fig. 2.

⁸ *Lonsdalia crassiconus*, M'Coy, Ann. of Nat. Hist., 2d series, vol. iii, p. 12.

4. LONSDALEIA DUPLICATA.

ERISMATOLITHUS (MADREPORITES) DUPLICATUS, *W. Martin*, Petrif. Derb., pl. xxx, 1809.

CARYOPHYLLIA DUPLICATA, *Fleming*, Brit. Anim., p. 509, 1828.

— — *S. Woodward*, Syn. Table of Brit. Org. Foss., p. 5, 1830.

CLADOCORA DUPLICATA, *Geinitz*, Grund. der Verst., p. 570, 1845-6.

LONSDALEIA? STYLASTRÆA FORMIS, *M'Coy*, Ann. of Nat. Hist., 2d series, vol. iii, p. 461, 1849.

LONSDALEIA CRASSICONUS, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d series, vol. iii, p. 12, 1849.

LONSDALEIA CRASSICONUS, *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 461, 1851.

LONSDALEIA CRASSICONUS, *M'Coy*, Brit. Palæoz. Foss., p. 103, pl. iii B, fig. 5, 1851.

LONSDALEIA DUPLICATA, *M'Coy*, ibid., p. 105.

LONSDALEIA STYLASTREIFORMIS, *M'Coy*, ibid., p. 106, pl. iii B, fig. 7.

Corallites in general free laterally, and having but slight, circular, mural growth swellings. *Septa* rather thin, and sub-equal; 24 or 26; exterior zone filled with very large vesicles. Diameter of the Corallites about 1 inch.

Found at Arnside, Kendal, Bakewell, Derbyshire, (Museum of Cambridge).

This species differs from *L. rugosa*¹ by the small development of the growth swellings of its epitheca; from *L. Bronni*,² by its *septa* being less numerous, and its *columella* smaller, and from *L. floriformis*,³ and *L. papillata*,⁴ by its *septa* being almost equally developed, and by the great size of the vesicles of its exterior zone.

GENERA INCERTÆ SEDIS.

1. Genus MORTIERIA, (p. lxxiv.)

MORTIERIA VERTEBRALIS.

MORTIERIA VERTEBRALIS, *De Koninck*, Anim. Foss. des Terr. Carb. de Belg., p. 12, pl. B, fig. 3, 1842.

— — *Michelin*, Icon. Zooph., p. 253, pl. lix, fig. 1, 1846.

— — *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 467, 1851.

Corallum short, cylindroid, having the form of a biconcave centrum of the vertebra of some fishes. About 100 septal radii. Diameter two or three inches; height, according to M. de Koninck, varying from 3 lines to 2 inches.

¹ See tab. xxxviii, fig. 5.

² Milne Edwards and Jules Haime, op. cit., tab. xi, fig. 1.

³ See tab. xliii, figs. 1, 2.

⁴ Milne Edwards and Jules Haime, op. cit., tab. xi, fig. 2.

Till lately this singular fossil had been found only in the carboniferous deposits of Tournay, in Belgium, but a specimen bearing the indication of Derbyshire was sent, together with other fossils, to the Museum of Paris, by Lady Hastings.

2. *Genus* HETEROPHYLLIA, (p. lxxiii.)

1. HETEROPHYLLIA GRANDIS.

HETEROPHYLLIA GRANDIS, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d ser., vol. iii, p. 126, figs. *a*, *b*, 1849.

— — *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 467, 1851.

— — *M'Coy*, Brit. Pal. Foss., p. 112, pl. iii A, fig. 1, 1851.

“Stem slightly flexuous, about 5 lines in diameter, scarcely tapering in 3 inches; longitudinally marked with deep unequal grooves, and few, large, polygonal, unequal ridges, giving a very irregularly angulose section to the stem; surface smooth; horizontal section, few, distant lamellæ, destitute of any order of arrangement, but irregularly branching and coalescing in their passage from the solid external walls towards some indefinite point near the centre, where the few main lamellæ irregularly anastomose. *Vertical section* showing about the middle an irregularly flexuous line, (the edge of one or two of the radiating vertical lamellæ,) from which, on each side, a row of thin, distant, sigmoidally curved plates extends obliquely upwards and outwards, forming a row of large rhomboidal cells on each side.

“Rare in the carboniferous limestone of Derbyshire.” (*M'Coy*, op. cit.)

2. HETEROPHYLLIA ORNATA.

HETEROPHYLLIA ORNATA, *M'Coy*, Ann. and Mag. of Nat. Hist., 2d ser., vol. iii, p. 127, 1849.

— — *Milne Edwards* and *Jules Haime*, Pol. Foss. des Terr. Palæoz., p. 467, 1851.

— — *M'Coy*, Brit. Pal. Foss., p. 112, pl. iii A, fig. 2, 1851.

“Stems sub-cylindrical, long, flexuous, averaging one and a half lines in diameter, with about sixteen narrow, sub-equal, longitudinal ridges, sharply defined, and separated by flat spaces rather wider than the ridges they separate; the ridges are set with small round tubercles more than their own diameter apart; surface very minutely granulose; internal structure as in the preceding species. *Horizontal section*, lamellæ about fourteen at the margin, (one usually coinciding with each external ridge).

“Rather rare in the carboniferous limestone of Derbyshire.” (*M'Coy*, op. cit.)

TAB. XXXI.

CORALS FROM THE MOUNTAIN LIMESTONE.

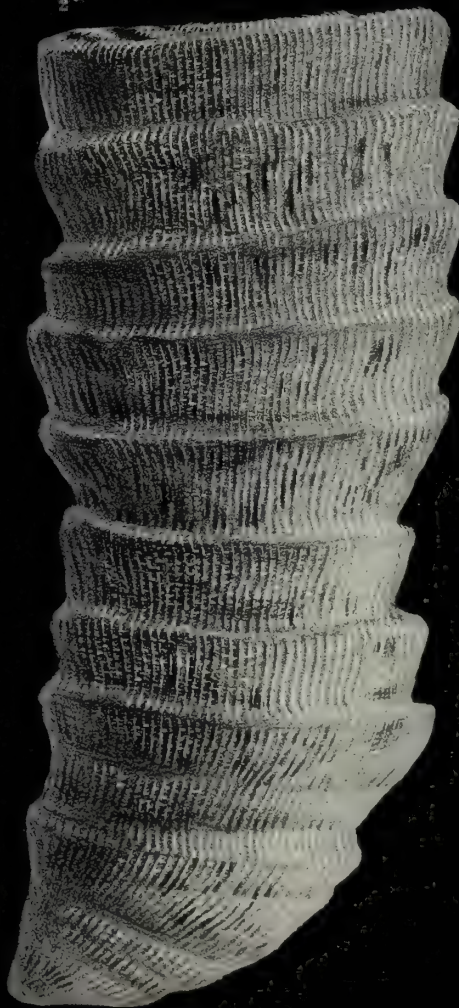
CYATHOPHYLLUM STUTCHBURYI (p. 179).

Fig. 1. Side view of a short specimen ; natural size.

1 *a*. Calice of a short specimen ; natural size.

2. Side view of a tall specimen ; natural size.

2 *a*. Another tall specimen, rather worn, and showing accretion ridges ; natural size.

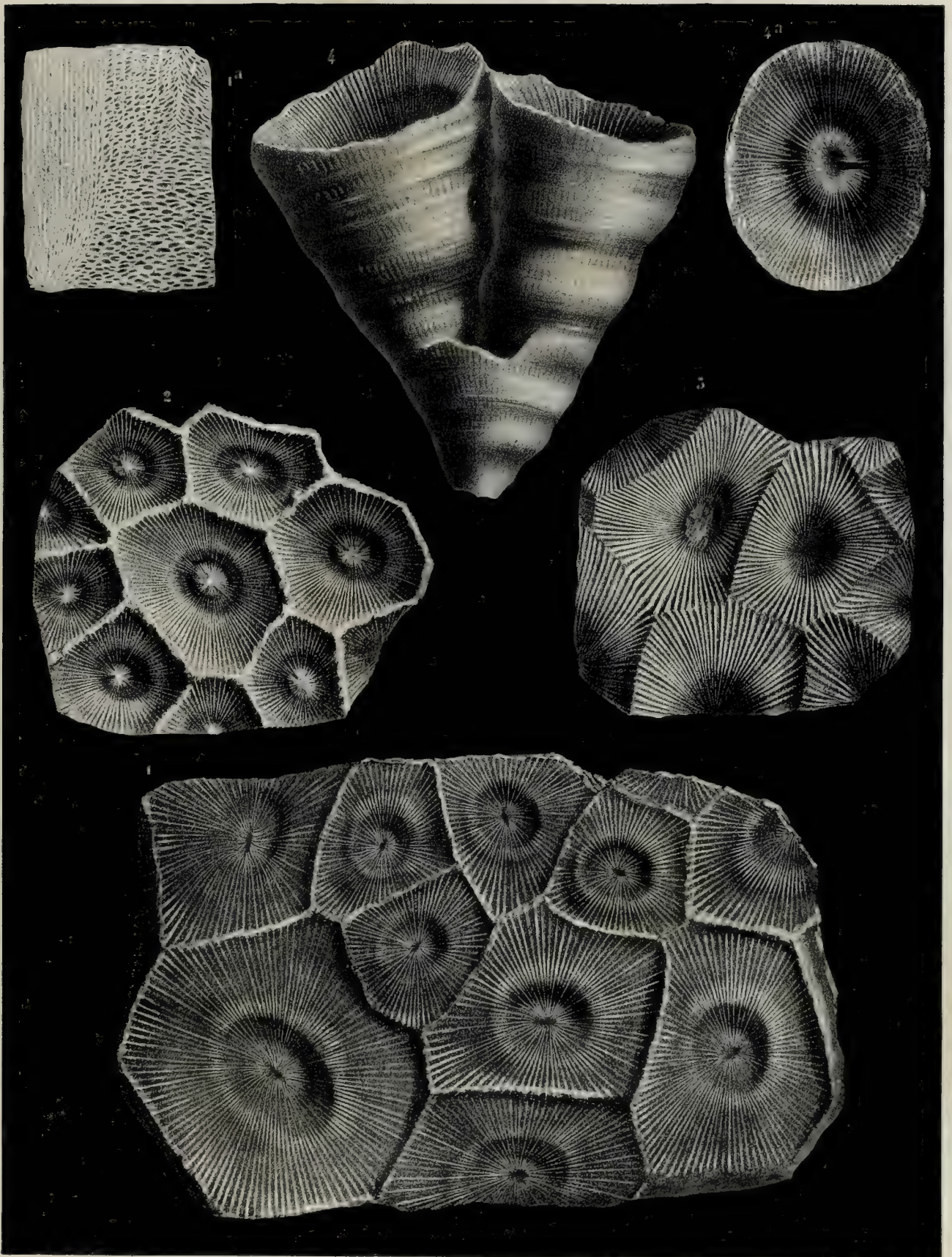


TAB. XXXII.

CORALS FROM THE MOUNTAIN LIMESTONE.

CYATHOPHYLLUM REGIUM (p. 180.)

1. A massive specimen, showing unequal calices ; the small ones on the upper front of the figure hide a large one ; natural size.
- 1 *a*. Small portion of a vertical section ; natural size.
2. Another specimen with thicker walls ; natural size.
3. Another specimen, in which the mural ridges are very thin and sharp ; natural size.
4. Two corallites issuing from the same parent, and showing exterior walls free laterally ; natural size.
- 4 *a*. A calice of the same ; natural size.



TAB. XXXIII.

CORALS FROM THE MOUNTAIN LIMESTONE.

CLISIOPHYLLUM TURBINATUM (p. 184).

Fig. 1. A short and stout specimen ; natural size.

1 *a*. Calice of the same ; natural size.

2. A long specimen which has lost its epitheca ; natural size.

CYATHOPHYLLUM MURCHISONI (p. 178).

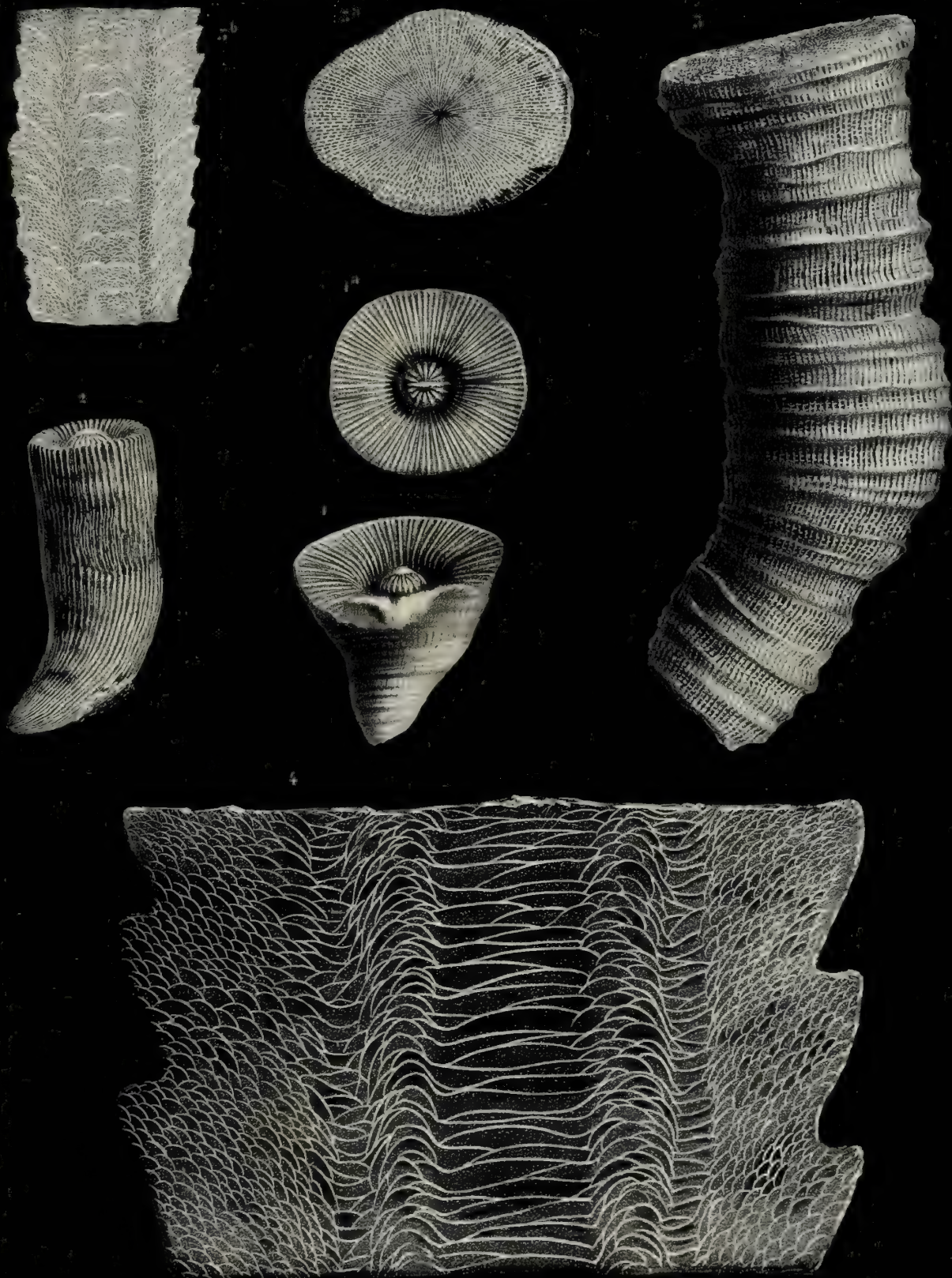
3. Side view of a long specimen, somewhat weather-worn ; natural size.

3 *a*. Horizontal section of the same ; natural size.

3 *b*. Vertical section ; natural size.

CYATHOPHYLLUM STUTCHBURYI (p. 179).

4. Part of a vertical section, magnified.



TAB. XXXIV.

CORALS FROM THE MOUNTAIN LIMESTONE.

ZAPHRENTIS ENNISKILLENI (p. 170).

- Fig. 1. A specimen, having half of its calice cut away, so as to show the septa and the septal fossule; natural size.

ZAPHRENTIS PHILLIPSI (p. 168).

2. Side view of an adult specimen; natural size.
2 *a*. A young specimen; natural size.
2 *b*. Calice of an adult specimen; magnified.

ZAPHRENTIS GRIFFITHI (p. 169).

3. Side view; natural size.
3 *a*. Calice; natural size.

ZAPHRENTIS BOWERBANKI (p. 170).

4. Side view; natural size.
4 *a*. Calice, magnified.

AMPLEXUS HENSLOWI (p. 176).

5. Side view; natural size.
5 *a*. Vertical section; natural size.

CYATHOPHYLLUM WRIGHTI (p. 179).

6. Side view; natural size.
6 *a*. Calice; natural size.

CYATHOPHYLLUM ARCHIACI (p. 183).

7. A specimen having half of the calice cut away; natural size.



TAB. XXXV.

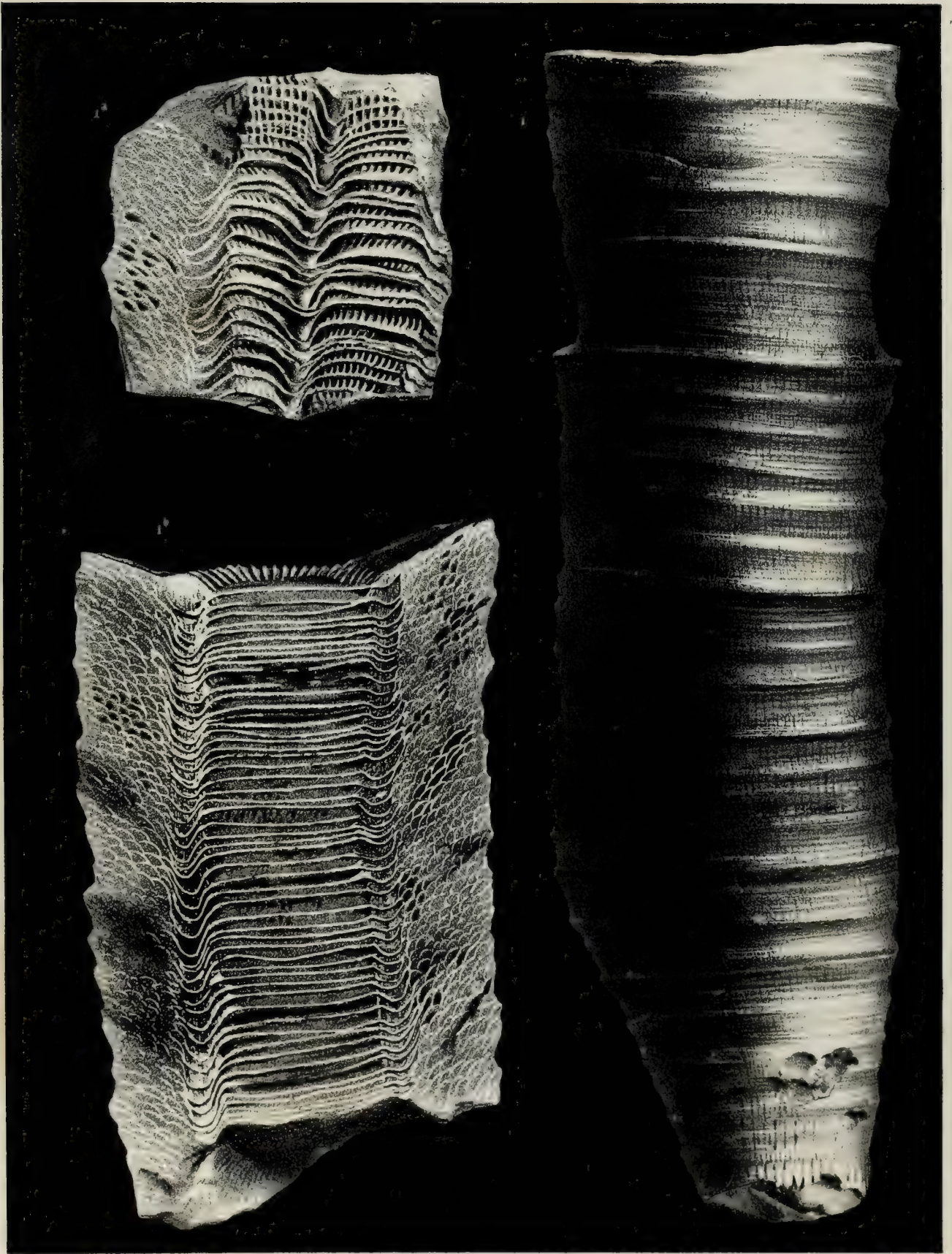
CORALS FROM THE MOUNTAIN LIMESTONE.

ZAPHRENTIS CYLINDRICA (p. 171).

Fig. 1. Side view of a straight specimen ; natural size.

1 *a*. A fragment broken away, so as to show form and relative position of the septal fossulæ.

1 *b*. Vertical section ; natural size.



TAB. XXXVI.

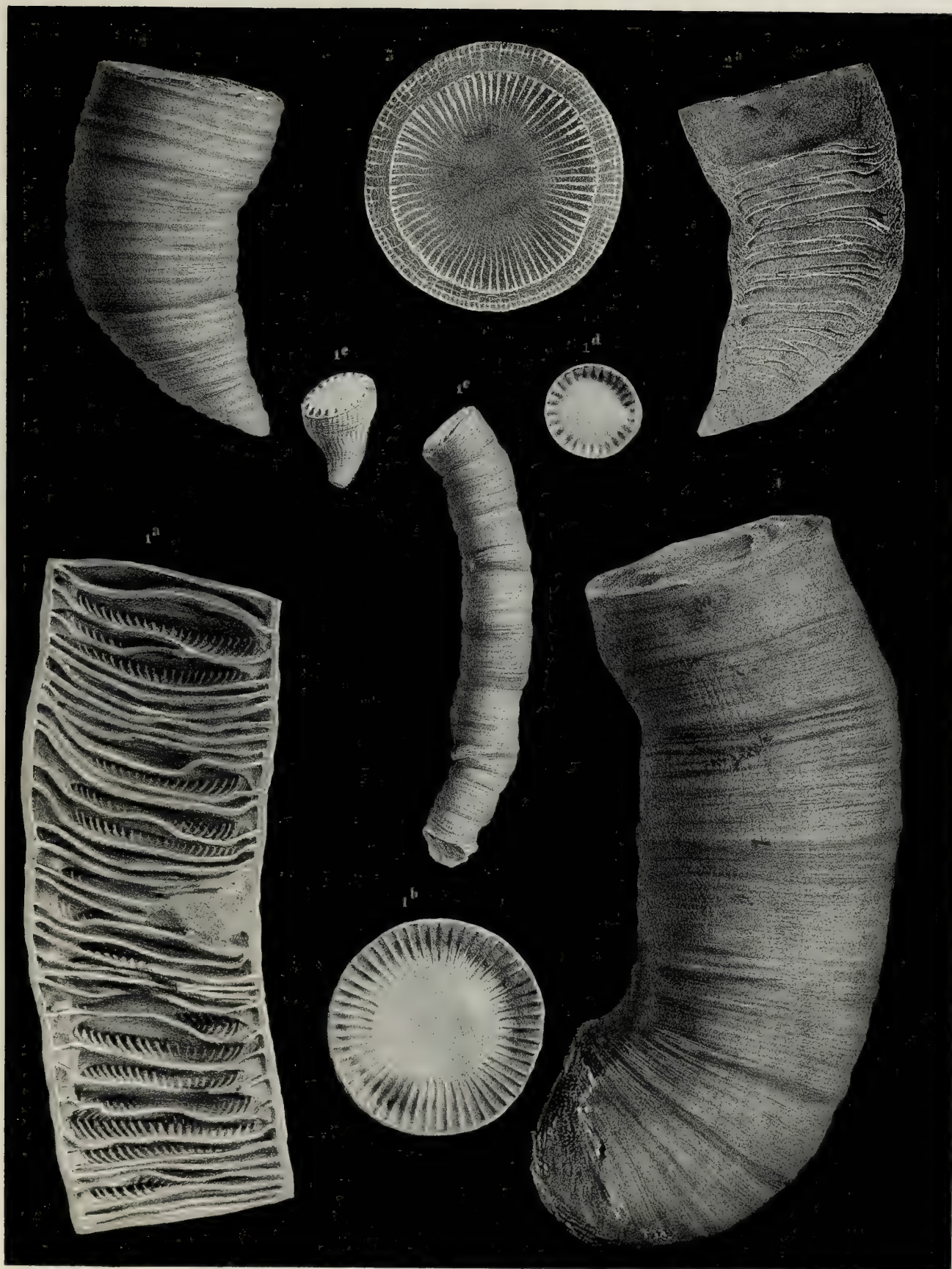
CORALS FROM THE MOUNTAIN LIMESTONE.

AMPLEXUS CORALLOIDES (p. 173).

- Fig. 1. Side view of a part of a large specimen; natural size.
- 1 *a*. Vertical section; natural size.
 - 1 *b*. Lower face of a tabula.
 - 1 *c*. Side view of a part of a slender specimen; natural size.
 - 1 *d*. Lower face of a tabula of the same.
 - 1 *e*. Lower part of a young specimen.

CAMPOPHYLLUM MURCHISONI (p. 184).

- Fig. 2. Side view; natural size.
- 2 *a*. Vertical section; natural size.
 - 3. Horizontal section of a larger specimen; natural size.



TAB. XXXVII.

CORALS FROM THE MOUNTAIN LIMESTONE.

CYATHOPHYLLUM PARRICIDA (p. 181).

Fig. 1. A gemmiferous Corallite, bearing up four young ones ; natural size.

1 *a.* A separated Corallite ; natural size.

1 *b.* Its calice, magnified.

PHILLIPSASTRÆA RADIATA (p. 203).

Fig. 2. A few calices; natural size.

2 *a.* Part of a vertical section, showing the lateral surface of a septum and five septal edges, magnified.

AULOPHYLLUM FUNGITES (p. 188).

Fig. 3. Side view ; natural size.

CLISIOPHYLLUM BOWERBANKI (p. 186).

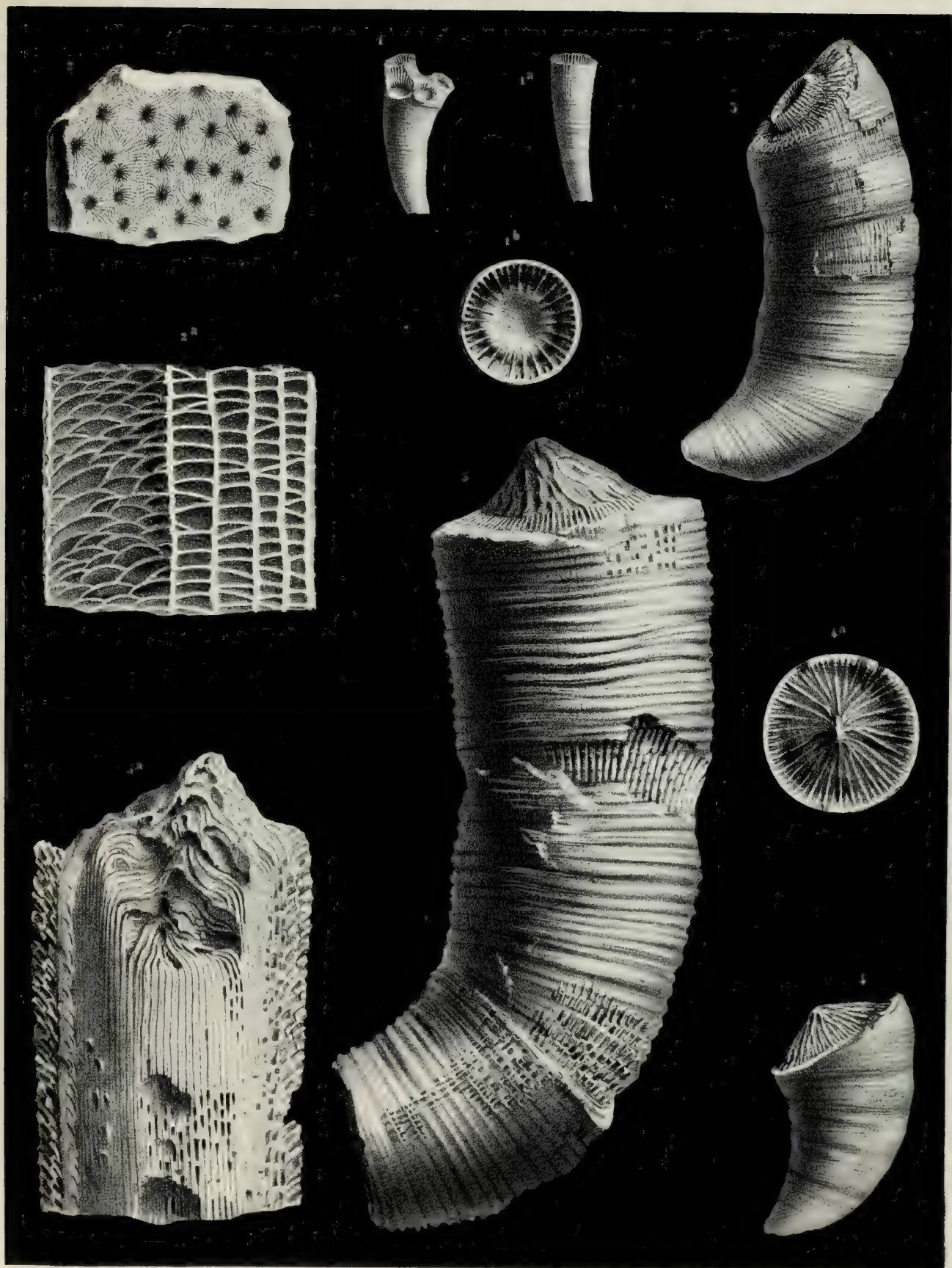
4. Side view of a specimen, having the margins of its calice cut away ; natural size.

4 *a.* Its calice; natural size.

CLISIOPHYLLUM CONISEPTUM (p. 185).

5. Side view of a specimen, partly broken at its two extremities; natural size.

5 *a.* Upper part of a broken specimen ; natural size.



TAB. XXXVIII.

CORALS FROM THE MOUNTAIN LIMESTONE.

AULOPHYLLUM BOWERBANKI (p. 189).

Fig. 1. A weather-worn specimen; natural size.

LITHOSTROTION ENSIFER (p. 193).

Fig. 2. Many calices; natural size.

2 *a*. Calices, magnified.

LITHOSTROTION BASALTIFORME (p. 190).

3. A few Corallites separated from a broken mass; natural size.

3 *a*. Horizontal section; natural size.

3 *b*. Part of a horizontal section, magnified.

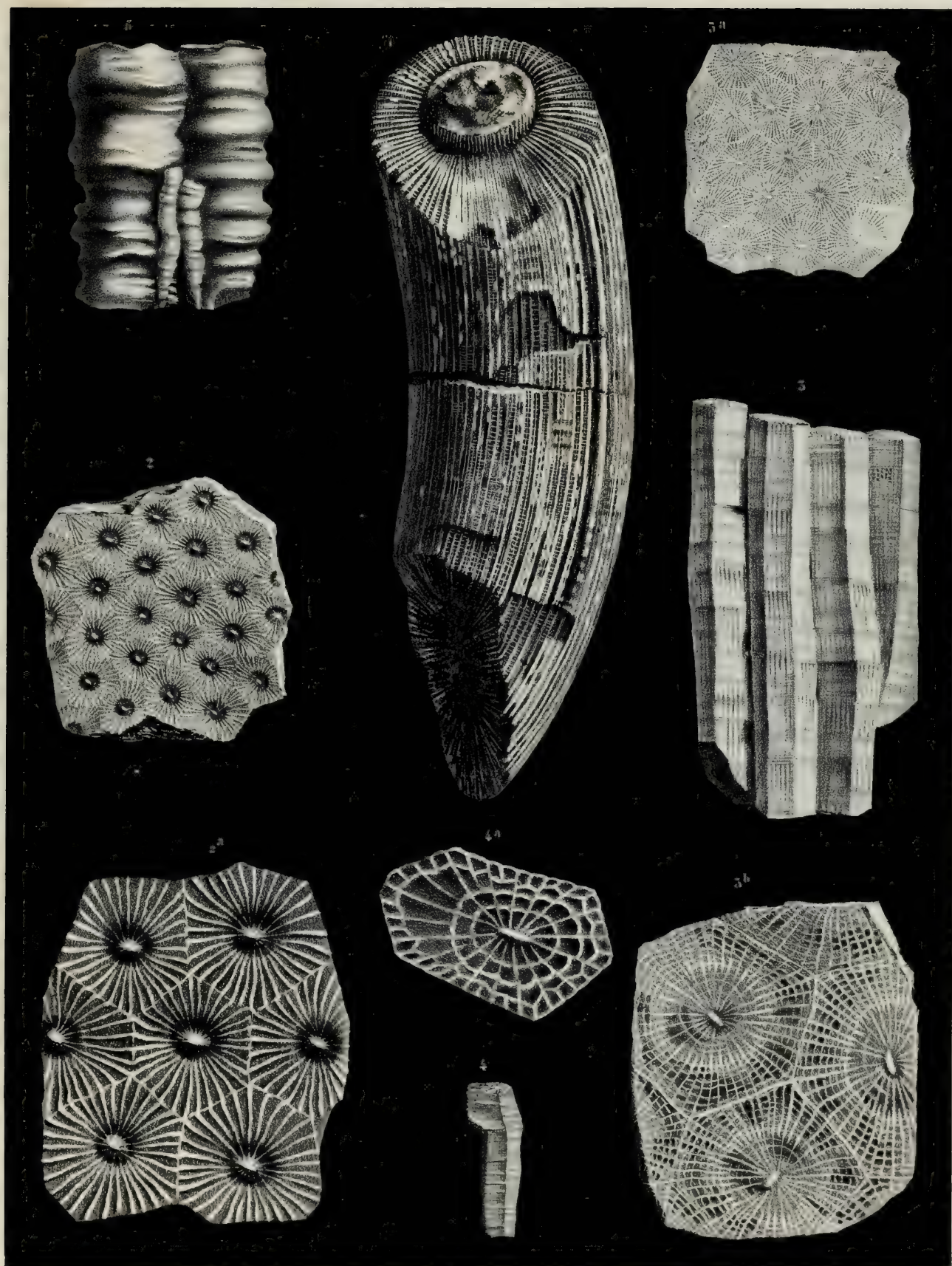
PETALAXIS PORTLOCKI (p. 204).

Fig. 4. A separated Corallite; natural size.

4 *a*. Its calice, magnified.

LONSDALIA RUGOSA, (p. 208).

5. Upper part of two Corallites, bearing young individuals; natural size.



TAB. XXXIX.

CORALS FROM THE MOUNTAIN LIMESTONE.

LITHOSTROTION ARANEA (p. 193).

Fig. 1. Horizontal section ; natural size.

1 *a*. Part of a horizontal section, magnified.

LITHOSTROTION AFFINE (p. 200).

Fig. 2. Side view of part of a group ; natural size.

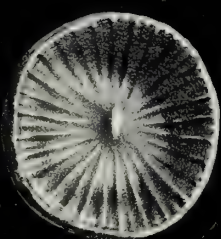
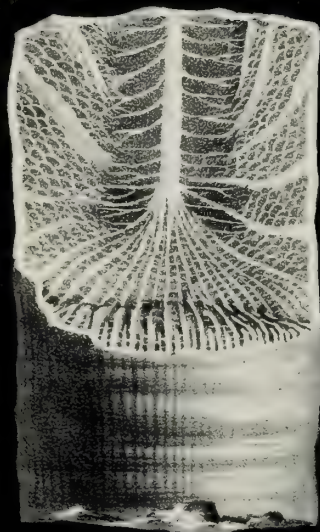
2 *a*. Calice magnified.

2 *b*. Oblique section, magnified.

LITHOSTROTION PHILLIPSI (p. 201).

Fig. 3. Side view of part of a specimen ; natural size.

3 *a*. Calice, magnified.



TAB. XL.

CORALS FROM THE MOUNTAIN LIMESTONE.

LITHOSTROTION JUNCEUM (p. 196).

Fig. 1. Side view of part of a tuft ; natural size.

1 *a*. Calice, magnified.

1 *b*. Vertical section of three Corallites, magnified. In one of these the columella has disappeared.

LITHOSTROTION MARTINI (p. 197).

Fig. 2. Side view of a tuft ; natural size.

2 *a*. Calice, magnified.

2 *b*. A transversal section of a specimen, in which the intermural spaces are filled up with extraneous matter ; natural size.

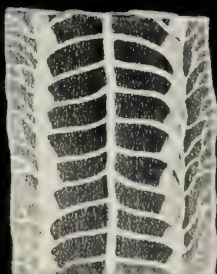
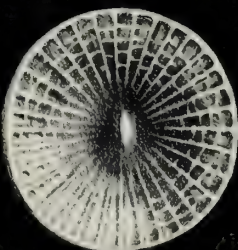
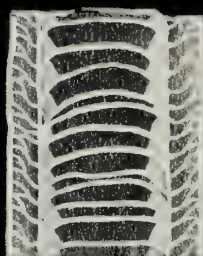
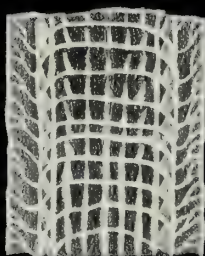
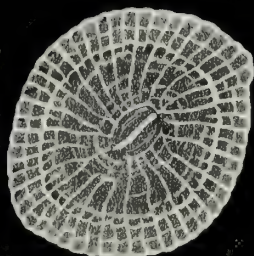
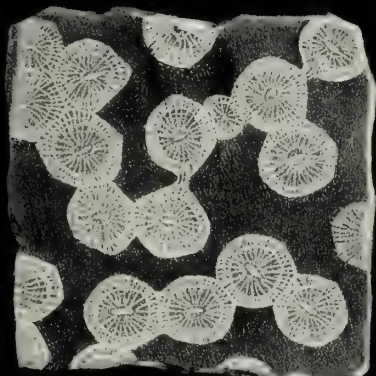
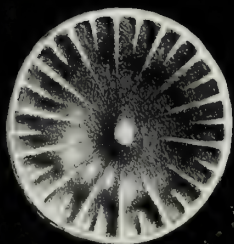
2 *c*. A vertical section of the same specimen ; natural size.

2 *d*. A horizontal section of a calice, magnified.

2 *e*. Part of a vertical section of a Corallite, magnified.

2 *f*. A similar Corallite, but destitute of its columella.

2 *g*. Vertical section not passing through the central axis, magnified.



TAB. XLI.

CORALS FROM THE MOUNTAIN LIMESTONE.

LITHOSTROTION IRREGULARE (p. 198).

Fig. 1. A specimen, partly broken ; natural size.

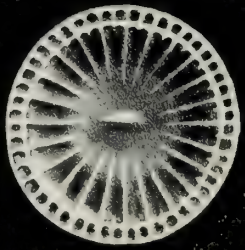
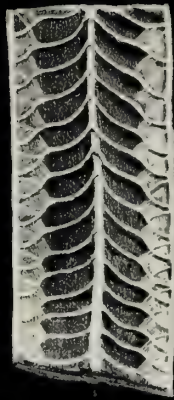
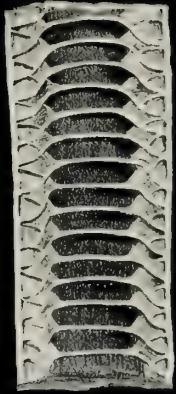
1 *a*. Inferior part of a tuft ; natural size.

1 *b*. Upper surface of a specimen, in which the intermural spaces are filled up with
extraneous matter ; natural size.

1 *c*. Calice, magnified.

1 *d*. Vertical section of a Corallite, magnified.

1 *e*. Vertical section of a Corallite not passing through the central axis, magnified.



TAB. XLII.

CORALS FROM THE MOUNTAIN LIMESTONE.

LITHOSTROTION PORTLOCKI (p. 194).

Fig. 1. A specimen quite massive ; natural size.

1 *a*. A massive specimen offering few corallites, free laterally ; natural size.

1 *b*. Calice, magnified.

1 *c*. Some Corallites separated from a massive specimen ; natural size.

1 *d*. One of these Corallites, magnified.

1 *e*. A vertical section, magnified.

1 *f*. Some calices having lost the columella.

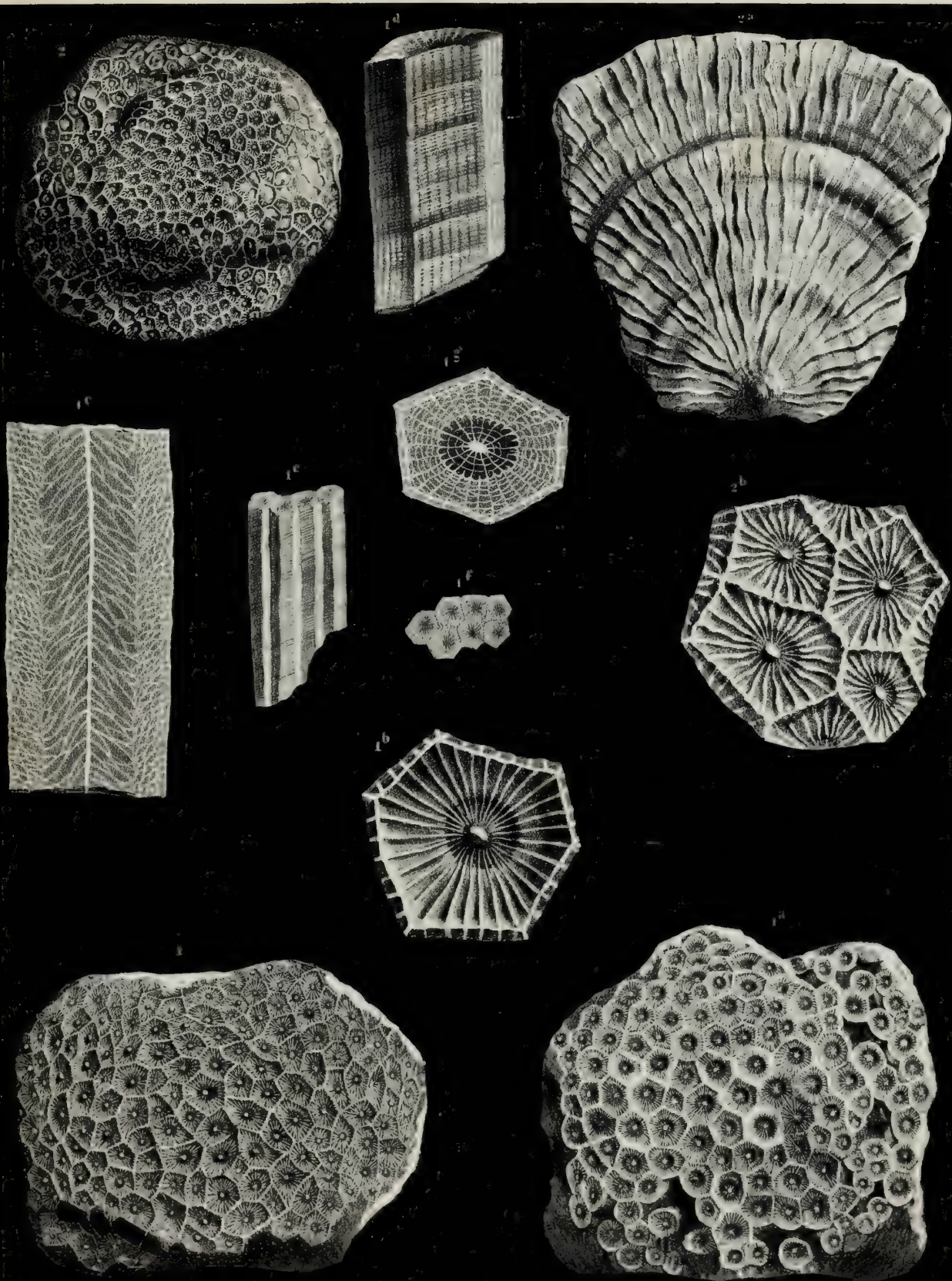
1 *g*. A horizontal section, magnified.

LITHOSTROTION M'COYANUM (p. 195).

Fig. 2. A gibbose mass ; natural size.

2 *a*. Under surface of a weather-worn specimen.

2 *b*. A few calices, magnified.



TAB. XLIII.

LONSDALIA FLORIFORMIS (p. 205).

Fig. 1. Part of a massive specimen ; natural size.

1 *a*. Two Corallites issuing from a common parent ; natural size.

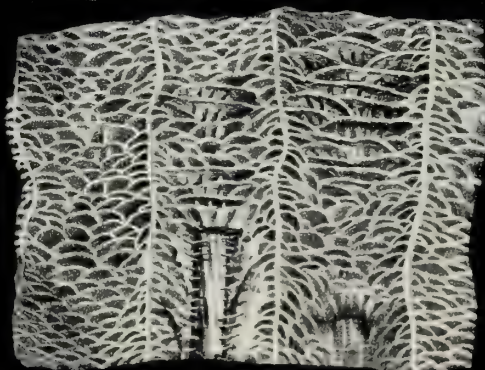
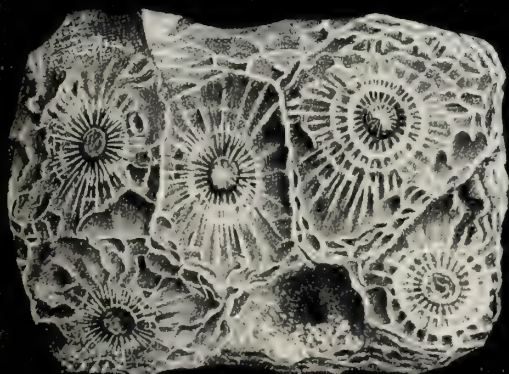
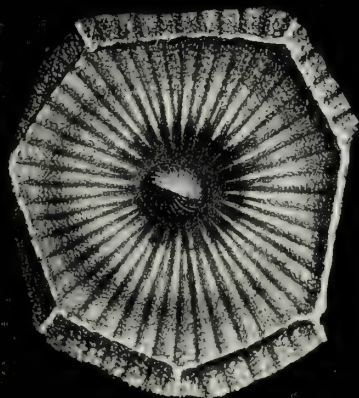
1 *b*. Side view of a young group.

1 *c*. Side view of another young group ; natural size.

1 *d*. Calice, magnified.

1 *e*. Part of a horizontal section, magnified.

2. *Varietas major*. A few calices, somewhat broken ; natural size.



TAB. XLIV.

CORALS FROM THE MOUNTAIN LIMESTONE.

MICHELINIA TENUISEPTA (p. 155).

Fig. 1. Side view of a small mass ; natural size.

1*a*. Upper view of the same specimen.

1*b*. Vertical section of a specimen embedded in extraneous matter ; natural size.

MICHELINIA FAVOSA (p. 154).

Fig. 2. A large broken specimen ; natural size.

2*a*. A few weather-worn calices, magnified.

2*b*. Side view of some Corallites separated from the broken mass ; natural size.

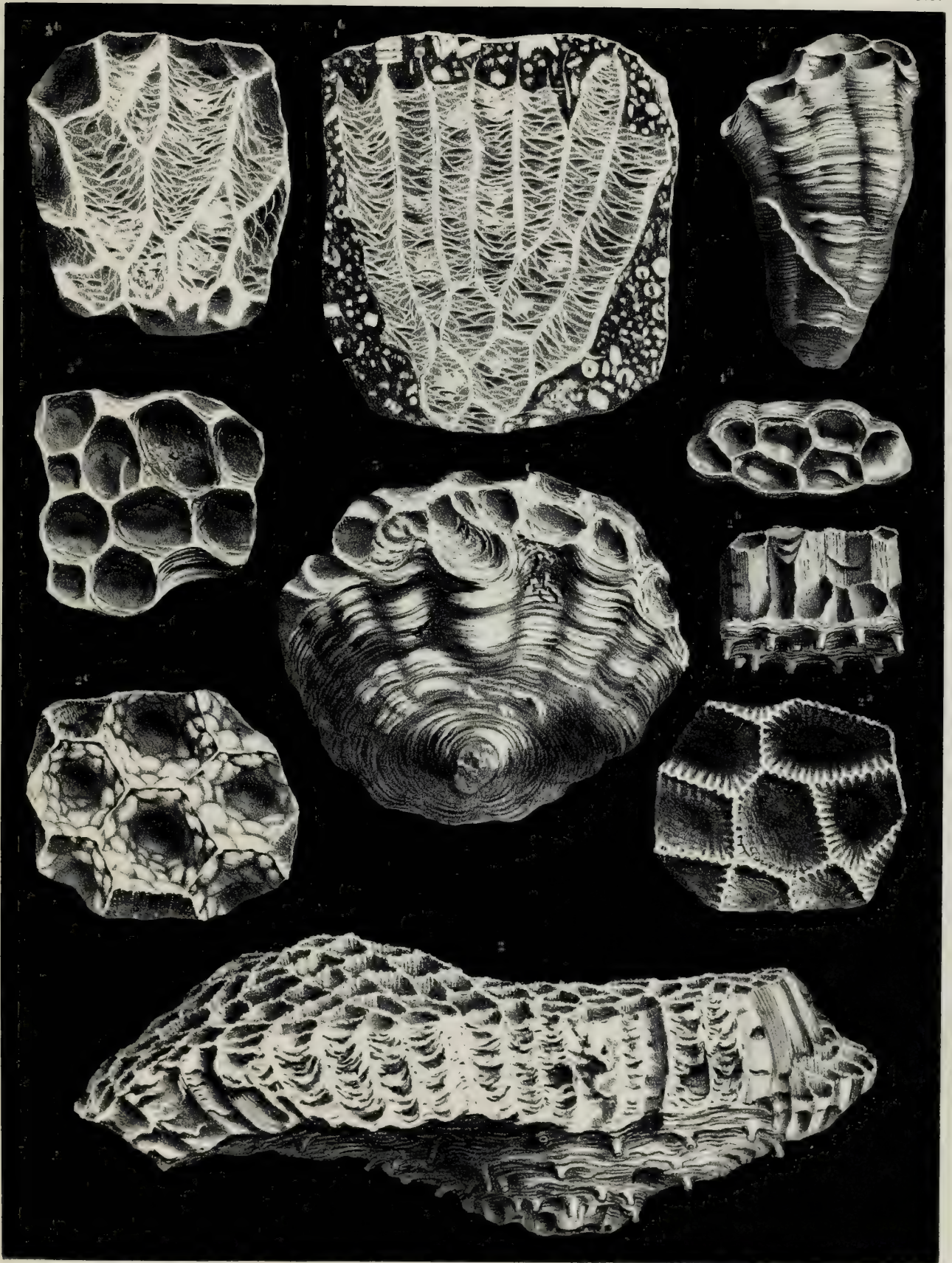
2*c*. A few calices in a good state of preservation, magnified.

MICHELINIA MEGASTOMA (p. 156).

Fig. 3. A subglobose specimen ; natural size.

3*a*. Some calices ; natural size.

3*b*. An oblique section ; natural size.



TAB. XLV.

CORALS FROM THE MOUNTAIN LIMESTONE.

BEAUMONTIA EGERTONI (p. 160).

Fig. 1. A broken mass ; natural size.

FAVOSITES PARASITICA (p. 153).

Fig. 2. A small globose specimen ; natural size.

CHÆTETES TUMIDUS (p. 159).

Fig. 3. A lobate specimen ; natural size.

3*a*. A vertical section, somewhat magnified.

3*b*. Calices, magnified.

ALVEOLITES DEPRESSA (p. 156).

Fig. 4. A gibbose mass ; natural size.

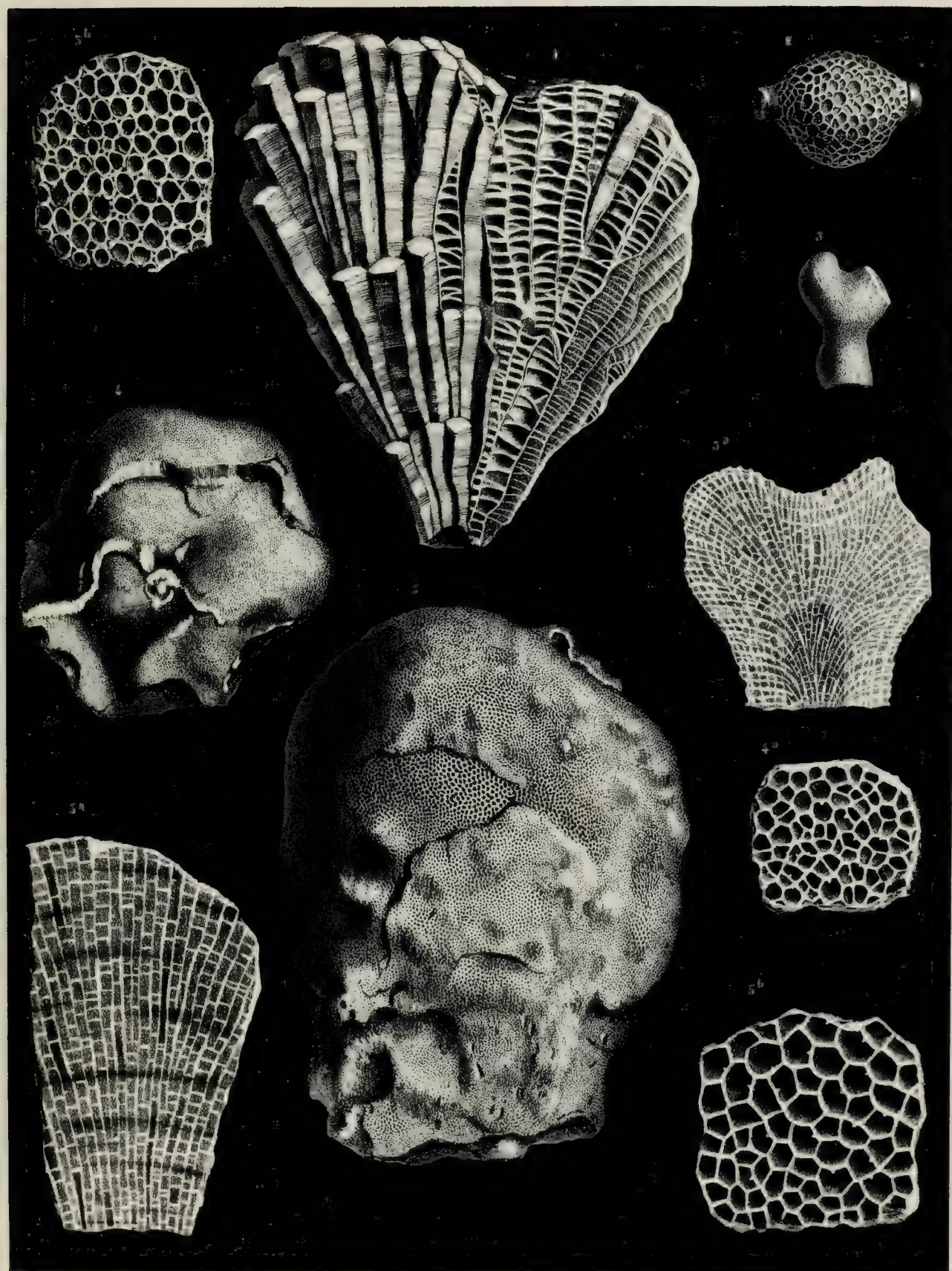
4*a*. Some calices, magnified.

ALVEOLITES SEPTOSA (p. 157).

Fig. 5. A subglobose mass ; natural size.

5*a*. A vertical section, magnified.

5*b*. Some calices, magnified.



TAB. XLVI.

CORALS FROM THE MOUNTAIN LIMESTONE.

SYRINGOPORA RETICULATA (p. 162).

Fig. 1. A portion of a tuft; natural size.

1*a*. A horizontal section of a specimen, in which the mural interspaces were filled up with extraneous matter.

SYRINGOPORA GENICULATA (p. 163).

Fig. 2. Side view of a broken tuft; natural size.

2*a*. Upper view of the same; natural size.

SYRINGOPORA RAMULOSA (p. 161).

Fig. 3. Lateral view of the upper part of some Corallites embedded within extraneous matter; natural size.

3*a*. A horizontal section, magnified.

3*b*. A vertical section, magnified.

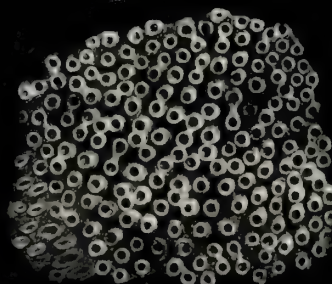
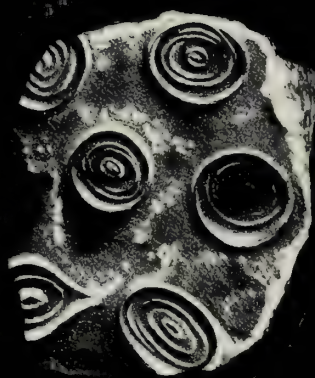
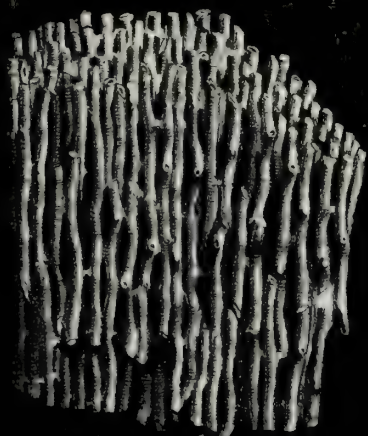
3*c*. Lower part of some broken Corallites.

4. A Corallum, supposed to be a small variety of *Syringopora geniculata*.

PYRGIA LABECHII (p. 166).

Fig. 5. Lateral view; natural size.

5*a*. Lateral view, magnified.



THE
PALÆONTOGRAPHICAL SOCIETY.

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MDCCCLII.

A MONOGRAPH
OF
BRITISH
TERTIARY BRACHIOPODA.

BY
THOMAS DAVIDSON,
MEMBER OF THE GEOLOGICAL SOCIETY OF FRANCE.

PART I.

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A MONOGRAPH

OF

BRITISH TERTIARY BRACHIOPODA.

PRELIMINARY REMARKS.

THE Tertiary Deposits, so rich in fossil remains of most classes of the Animal Kingdom, are remarkably poor in Brachiopoda, few species having lived at that period, especially when compared with the multitude of forms that filled the Cretaceous, Oolitic, and Palæozoic seas; the whole class having singularly diminished in number after the cretaceous period up to the present day; for, out of from fifty to sixty recent species, only five are found alive near our shores.

Our supercretaceous strata is principally made up of a vast assemblage of clays, sand and sandstones, gravel and limestones; succeeding and alternating with one another, and sometimes acquiring great thickness and extent. The division of these strata into distinct periods has been the study and aim of many of our most eminent Geologists, who generally seem disposed to admit three principal divisions, as follows:

<i>Tertiary Formations</i>	{	Upper . . . Supérieur . . . (Pliocene of Sir C. Lyell.)
		Middle . . . Moyen . . . (Miocene „ „)
		Lower . . . Inférieur . . . (Eocene „ „)

But the exact limits of these have not, in our opinion, been completely established. Some authors object to the use of the terms *Eocene*, *Miocene*, and *Pliocene*, and M. D'Orbigny in particular, in a small work he has lately published,¹ wherein he proposes to replace Sir Charles Lyell's names by those of—

¹ 'Cours élémentaire de Paléontologie et de Géologie Stratigraphiques,' Première Partie, p. 260, 1850; and 'Prodrome de Paléontologie Stratigraphique Universelle,' vol. i, Introduction, p. xliv, 1849.

Terrains Tertiares	{	27. Subapennin,
		26. Falunien,
		25. Parisien,
		24. Suessonien,

to avoid the *Cènes*, as he declares to have found the identifications of the recent Eocene species inexact, and not existing in the recent state. Without wishing to decide the question of who is right, and what names should be adopted in preference to others, we shall admit three great divisions, *Lower*, *Middle*, and *Upper*, each liable to subdivision, as shown by Sir C. Lyell, D'Archiac, and other authors. The important facts lately brought to light in the arrangement of the lower division, are mainly due to the zealous and indefatigable researches of Mr. Prestwich,¹ that author having established that the Barton clays and Braklesham sands were the equivalents of the French *Glauconic Grossiere*, or lowest beds of the Calcaire Grossier, while the London clay and Bognor rocks represent the French *Sables Inférieurs*, and *Lits Coquilliers*. The *Middle Division*, or *Miocene*, appears wanting in our island, and therefore we will not allude to it, but mention that the *Upper Division*, or *Pliocene*, is well represented in our island, and may, like the other great divisions, be subdivided into distinct periods. This upper division, comprising our newest Tertiary Deposits, is composed of sands, gravel, irregular beds of limestone, and layers of greenish marl, known by the name of Crag. These have been divided into three sub-divisions, viz., the *Coralline*, the *Red*, and the *Mammaliferous Crags*.

Some Geologists place the Coralline and Red Crag in the Miocene periods, and the upper crag in the Pliocene.² Others have separated the two lower crags, placing one in the Miocene and the other in the Pliocene;³ and lately,⁴ the two lower crags have been considered as belonging to one period (*older Pliocene*), and the upper or Norwich crag (*newer Pliocene*).

Mr. S. Wood objects, however, to this arrangement, now considering the crags to belong to three distinct periods; so that, by subdividing the newer Pliocene into lower (Coralline Crag), medial (Red Crag), and newer (Norwich or Mammaliferous Crag), we would be nearer the probable state of things as far as our island is concerned.

I have deemed it necessary to enter into these few details in order to explain the reasons why we arrange the different species contained in this Monograph more in one period than in another.

For more ample details on the Geology of this system, we would refer to the works

¹ 'Quarterly Journal of the Geol. Soc.,' Nov., 1847.

² See Viscount d'Archiac's 'Histoire de Progrès de la Géologie de 1834 à 1845,' vol. ii, 2de partie, p. 447, &c., 1849.

³ See S. Wood, 'Monograph of the Crag Mollusca,' Introduction, 1848. (Mr. S. Wood is now, however, of a contrary opinion, placing all the Crags in the newer Tertiaries.)

Also formerly by Sir C. Lyell.

⁴ Sir Charles Lyell, 'A Manual of Elementary Geology,' p. 362, 1851.

of our British and Foreign Geologists. Of the nine species discovered in the supercretaceous deposits of our island, four exist still in the recent state, three of which are found near our coasts. It has therefore been thought advisable to include, in this Monograph, our few recent species so closely connected with the fossil ones, ably described and illustrated by Professor Forbes and Mr. S. Hanley in their excellent work on British Mollusca, which valuable information has assisted me so materially in drawing up the descriptions of our five recent species.¹

It is stated by Professor Forbes, that "Brachiopods are so rare or so local in the British seas, that ordinary collectors are not likely to meet with any. Not long ago a British Brachiopod was one of the brightest gems in any collection so fortunate as to contain it. Three or four minute and undeveloped examples of *Ter. caput-serpentis* and a few *Crania* were all we were likely to meet with, after exploring the great majority of public and private cabinets: of late years a great number of that interesting Terebratula have been taken, and *Crania* has also been found in abundance, so that there is no difficulty in obtaining an indigenous type of the order."

The other three species are still great rarities, two of which, *Ter. cranium* and *Rhynchonella psittacea*, being only known by a few solitary specimens. In the upper Tertiaries, of the six known species, one only, *Ter. grandis*, may be called common, and in the lower Tertiaries of the three forms mentioned, one only has hitherto been found in an incomplete state.²

¹ Consult Sir Charles Lyell's works; those of Mr. Webster, in the 'Geol. Transactions,' vol. i; Mr. Prestwich's excellent papers in the 'Quarterly Journal of the Geol. Soc.;' those of Mr. Charlesworth, in the 'Mag. of Nat. Hist.,' 1837, and 'Phil. Mag.' for 1835; S. Wood, in the 'Annals of Nat. Hist.' and Palæontographical Society's works; Viscount d'Archiac's numerous papers, particularly his 'Essai sur la Coordination des Terrains Tertiaires' ('Bull. Soc. Géol. de France,' vol. x, p. 168, 1839,) and 'Histoire des Progrès de la Géologie,' vol. ii, 2de partie, 1849; as well as the works of Cuvier and Brongniart, Constant Prevost, Deshayes, Sowerby, Hebert, D'Orbigny, F. Edwards, &c. &c.

² It gives me very much pleasure in here stating, that since the publication of last year's portion of my work, I have again received kind and zealous assistance from many of the gentlemen there named; and I have now the pleasure of adding those of Messrs. S. Wood, Fitch of Norwich, Harris of Charing, Catt of Brighton, Image of Whelpstead, Wood of Richmond (Yorkshire), Falkner of Devizes, Ferguson of Redcar, Prof. Sedgwick, Mr. Carter of Cambridge, Mackey of Folkstone, R. Jones, Griffith of Dublin, Dr. Lewis, and MM. D'Orbigny and Schnurr, who have liberally lent me the specimens contained in their valuable local collections.

BRITISH TERTIARY BRACHIOPODA.

The different recent and supercretaceous species of Great Britain may be thus arranged :

TERTIARY OR SUPERCRETACEOUS EPOCH.	RECENT		Found in deep water near our shores	<i>Crania anomala.</i> <i>Argiope cistellula.</i> <i>Terebratulina caput-serpentis.</i> <i>Terebratula cranium.</i> <i>Rhynchonella psittacea.</i>
	Upper division, Pliocene.	Upper or Newest div., Pliocene.	Fluvio-Marine Crag of Norwich, composed of sand and loam, with numerous remains of mammalia, a few land and fresh water ; and many ma- rine shells.	<i>Rhynchonella psittacea.</i>
		Middle div., Pliocene.	Red Crag, composed of sands, gravel, and loam, stained by oxide of iron, abounding in shells, often much rolled and waterworn.	<i>Terebratula grandis.</i>
		Lower div., Pliocene.	Coralline Crag, made up of calcareous sand, flaggy beds of limestone, and small lay- ers of greenish marl, abound- ing in mollusca, corals, Zoo- phytes, &c.	<i>Orbicula lamellosa ?</i> <i>Lingula Dumontieri.</i> <i>Argiope cistellula.</i> <i>Terebratulina caput-serpentis.</i> <i>Terebratula grandis.</i>
		Middle division, Miocene.	Wanting	
		Upper div., Eocene.	Wanting	
	Lower division, Eocene.	Middle div., Eocene.	Fresh water and fluvio-marine beds of Headon Hill, Barton clay, limestone, clays and sands (no Brachiopoda), Bag- shot and Bracklesham beds of clay, grey and green sands, and sandy beds.	<i>Ter. bisinuata !</i>
		Lower div., Eocene.	London clay and Bognor beds, clays and limestones, plastic clay, &c.	<i>Lingula tenuis.</i> <i>Terebratulina striatula.</i>

CHALK.

Genus—LINGULA, *Bruguère*. 1789.

Shell inequivalved, one valve more convex than the other, more or less oval, elongated, tapering, and pointed at the beaks, widened at its pallear region, without hinge, valves held together by the adductor muscles; attached to submarine bodies by a long muscular peduncle issuing from between the beaks, a groove existing for its passage in that of the larger valve, without any shelly support; structure horny, covered by an epidermis; two muscular impressions on the one, four on the other valve.¹

Obs. We are not acquainted with any recent British *Lingula*. Two species are found in the Tertiary strata.

1. LINGULA DUMONTIERI, *Nyst*. Plate I, figs. 10, 10^{a b}, 11.

LINGULA DUMONTIERI, *Nyst*. Coq. et Poly. Test. de la Belgique, p. 337, pl. xxxiv, fig. 4^{a b c}, 1843.

— MYTILOIDES, *Nyst*. 1835. Rech. sur les Coq. Fos. d'Anvers, p. 21, pl. iv, fig. 80 (non Sow.)

— FUSCA, *S. Wood*. Mag. of Nat. Hist., p. 253, 1840, (not figured or described.)

— — *Morris*. Cat. of Brit. Fossils, p. 122, 1843.

— — *Bronn*. Index Pal., p. 655, 1848.

— — *Tennant*. A Stratigraphical List of British Fos., p. 17, 1847.

Diagnosis. Shell almost inequivalve, of a lengthened oblong form, valves convex, slightly compressed, and rounded anteriorly; beak acute, not much produced; shell thin, and brittle; surface smooth, shining, of a ferruginous brown colour, and marked by numerous concentric lines of growth. Muscular impressions strongly marked in the interior of both valves, arranged in pairs, as in all *Lingulas*. Length 12; width 5 lines.

Obs. This species seems to have been first noticed in the Crag of Antwerp by M. Nyst, under the erroneous name of *L. mytiloides*, Sow., which error was afterwards acknowledged by the same author in another work. In England, it was first discovered in the Coralline Crag of Sutton by Mr. S. Wood, who published it under the appellation of *L. fusca*, unfortunately without figure or description, in the 'Annals of Nat. Hist.,' 1840; later in 1843 it was described and figured by M. Nyst, under the name of *L. Dumontieri*, which denomination we feel bound to accept in preference to that of Mr. S. Wood, as a species published without description or figure cannot claim priority. M. Nyst mentions it as abounding in the Crag of Antwerp, where it has not, however, been found perfect, the anterior portion being always broken, and this is generally the case with most of our English specimens, no doubt owing to the extreme thinness of its shell. *L. Dumontieri* somewhat approaches in form to *Lingula Hians* (Swains), from Port Essington, but it is perhaps smaller and more acute posteriorly. However, it is difficult to distinguish the different

¹ For more ample details, see General Introduction.

species of *Lingula*, as these generally vary but little from one another. Sir C. Lyell remarks, in his 'Elementary Geology,' that the presence of species of *Lingula* in the Crag is worthy of notice, as these Brachiopoda seem now confined to more equatorial seas.

Plate I: figs. 10 and 11, are figured from specimens found in the Crag of Sutton, and kindly lent to me by Mr. S. Wood.

Fig. 10^a. Interior of the smaller valve considerably magnified.

Fig. 10^b. Interior of the larger valve likewise magnified.

2. *LINGULA TENUIS*, Sow. Plate I, fig. 12.

LINGULA TENUIS, Sow. M. C., tab. xix, fig. 3, p. 55, vol. i, 1812.

— — *Morris*. Catalogue, 1843.

— — *Tennant*. A Stratigraphical List of Br. Fossils, p. 32, 1847.

— — *Bronn*. Index Pal., vol. i, p. 656, 1849.

Diagnosis. Shell of a lengthened, lanceolate, oval form, flattish, the anterior edge short and straight; surface smooth, bright and shining, marked by numerous concentric lines of growth. Length 5; width $1\frac{1}{2}$ lines.

Obs. This small species is described by Sowerby as not unfrequent in the sandy limestone of Bognor. It has also, I believe, been found near Highgate, in the London Clay; it is easily distinguished from *Lingula Dumontieri*, Nyst, (*L. fusca*, S. Wood,) by its dimensions and more lanceolate shape.

Plate I, fig. 12, from the original specimens in the Min. Con.; we regret having been unable to procure better specimens for illustration.

Genus—ORBICULA, Cuvier. 1808.

Shell inequivalved, more or less orbicular, upper valve conical, with apex inclining towards the posterior margin, lower valve depressed, pierced by a longitudinal fissure, from which issues a tendinous pedicle spreading over a small disk placed near the posterior part of the lower valve, and externally adhering to rocks, corals, and other substances; valves smooth, concentrically lamellose or longitudinally striated; structure almost entirely horny; animal symmetrical, mantle free all round, with numerous long, horny and unequal cilia, body small; no calcareous supports; arms fleshy, ciliated, and united at their origin above the mouth, free only at their short spiral portion; muscular system composed of eight distinct muscles, leaving two oval impressions in upper or unattached valve, near the posterior margin, and two others near the palleal region.¹

Obs. We are not acquainted with any British recent orbicula, one only is found in the supereretaceous deposits.

¹ For more ample details, consult Professor Owen's excellent description of the animal of this genus, 'Zool. Trans.,' vol. i, 2d part.

3. ORBICULA LAMELLOSA? *Brod.* Plate I, fig. 9, 9^{a b}.ORBICULA LAMELLOSA, *Brod.* Zool. Proc., 1833, p. 124.DISCINA NORVEGICA? *S. Wood.* Mag. Nat. Hist., 1840.ORBICULA NORVEGICA, *Tennant.* A Stratigraphical List of British Fossils, p. 17, 1847.

Diagnosis. Shell inequivalved, nearly orbicular, longer than wide; upper valve of a flattened conical form, much depressed, vertex acute, prominent, situated at a third of the length of the valve from the posterior margin; surface ornamented only by minute concentric lamella or lines of growth; colour a ferruginous yellow. Structure horny. Length 2, width 1 $\frac{2}{3}$ lines.

Obs. The discovery of this small orbicula is due to Mr. S. Wood, who found it in the Coralline Crag of Sutton. Unfortunately only one imperfect specimen of the upper valve has been procured, so that its determination is difficult and uncertain. We have referred it for the present to the recent *Orbicula lamellosa*, which it resembles, until a perfect specimen comes to light, on which a more accurate determination may be arrived at; it has also something of the appearance of *O. laevis*. Mr. S. Wood, in his 'Catalogue of Crag Mollusca,' attributes it to the *Discina norvegica*, which seems a mistake, that species being *Crania* (*Patella*) *anomala* of Müller. *O. lamellosa* is at present found recent in various parts of the coast of Peru; and is, as well as all the species of the genus, an inhabitant of tropical latitudes; and we may here state, also, that it is found in company with a *Lingula L. Dumontieri*, a genus likewise peculiar to much warmer seas than those which wash our shores.

Fig. 9. A specimen, natural size, from the Collection of Mr. S. Wood.

Fig. 9^{a b}. Enlarged representations.¹

¹ It has been thought advisable to introduce a reference to the only recent *Cranium*, *C. anomala*, that occurs in the British Seas, in order to render the sequence of genera referred to in the table complete.

Otho Frederic Müller appears to have been the first to bring this species into notice, styling it "*Vermis singularissimus*," and placing it as an anomalous form of *Patella*: it has been well described by Professor Forbes, in his work on 'British Mollusca.' He states: "The arms are extended horizontally, each forming a rather short, graceful, plume-like curve; the fringes are long, rather stiff, and can be extended slightly beyond the shell; they are of a fleshy white colour; when the upper valve is removed, the fringed arms are seen lodged in it; the ramifying ovaries, which are of a tawny hue, remain on the under valve."

This species has hitherto been only found in the recent state; and it appears common near some of our shores, especially on the West Coast of Scotland. It was first found adhering to stones in deep water in Zetland by Dr. Fleming. Professor Forbes adds many interesting details relative to the localities and depth of water in which it has been collected. Thus, he adds, it is found "off Arran in twenty fathoms (Smith); Loch Fyne in thirty to eighty fathoms; plentiful on stones off Mull in twenty and ninety fathoms; off Lismore in from twenty to thirty fathoms; off Armadale in eighteen fathoms; off Copenhaw Head, Skye, in forty fathoms; on the Ling Banks off Zetland in fifty fathoms (M'Andrew and E. F.); Loch Alsh, Loch Carron, Ullapool, East of Lerwick, in forty fathoms (Jeffreys). In Ireland it has been taken off Youghal by R. Ball, and off Cork by Humphreys. It ranges throughout the Scandinavian seas."

Plate I, fig. 1. Specimens, natural size.

„ fig. 1^a. Interior of attached valve, considerably enlarged.

„ fig. 1^b. Interior of upper valve, enlarged.

Genus—ARGIOPE, *Deslongchamps*. 1842.

MÉGATHIRIS, *D'Orb.* 1847.

Shell inequivalved, variable in shape, semi-orbicular, quadrate, or transversely oval. Valves unequally convex, smooth, or variously ribbed. The larger valve deep, beak produced with a large depressed triangular area; foramen large, completed by the umbo of smaller valve, which generally becomes indented from the shortness of the peduncle, forcing the beak and umbo to lie close to the rock coral or other objects to which it is attached, and thus wearing by friction that portion of the shell; structure strongly perforated; margin thickened and granulated. Hinge-line straight; valves articulating by means of two single teeth in the larger valve, and corresponding sockets in the smaller one. Interior of the smaller valve furnished with a central septum, and sometimes with one or more lateral septa, radiating from beneath the muscular fulcrum, and terminating at some distance from the margin in elevated processes. Apophysary system consisting of a distinct loop originating at the base of the dental sockets, and furnished with converging processes; the loop is folded into two or more lobes, occupying the interspaces of the radiating septa, to which they adhere on their inner sides.

Obs. The shells composing this genus were first separated from *Terebratula* by M. Deslongchamps,¹ who pointed out its principal differences and affinities to *Thecidea*, the recent *Anomia decollata*, Chemnitz, or *detruncata*, Gmelin, being named as the type; later M. D'Orbigny (probably unacquainted with M. Deslongchamps' claims of priority) proposed likewise to separate the shells in question from the *Terebratulæ* under the generic name of *Megathiris*;² since that period the genus has been re-described by Professor Forbes,³ who, unacquainted with M. Deslongchamps' priority, adopted M. D'Orbigny's name. It is well figured in several works;⁴ but on the most important character of the genus authors have not yet agreed, namely, *if the shell was provided with fleshy arms or not*. M. D'Orbigny and Dr. Philippi are stated to have examined the animal anatomically, and to have found none, while Professor Forbes, who has had the same advantages, affirms the animal to be possessed of contorted spiral arms fixed to the margin of the apophysary septa above described, and to the cardinal teeth.⁵ Mr. J. E. Gray⁶ places this

¹ 'Mém. de la Soc. Linn. de Normandie,' vol. vii, p. 9, 1842. M. Deslongchamps' detailed paper appeared in the 'Bull. de la Soc. Géol. de France,' vol. vii, 2d ser., p. 65.

² 'Comptes Rendus Hebdomadaires de l'Académie des Sciences,' August, 1847. Also in the 'Annales des Sciences Nat. Zool.,' tom. viii, p. 241, 3d sec., 1847; and 'Palæontologie Française Terrains Crétacés,' vol. iv, p. 146, 1847.

³ Forbes and Hanley, 'British Mollusca,' vol. ii, 1849.

⁴ In 1785, by Chemnitz, pl. lxxviii, fig. 705; by Sowerby, 'Thesaurus Conchyliorum,' pl. lxxi, fig. 70, &c.

⁵ Since writing the above, Professor Forbes informs me that it must have been a small *T. seminulum* he examined, and not an *Argiope*.

⁶ J. E. Gray, 'Annals of Nat. Hist.,' vol. xiv, pp. 271—9.

genus in his second order, or *Cryptobranchia*, stating the oral arms to be "entirely attached in the form of two or more lobed processes sunk into grooves in the disk of the ventral valve." Again Professor King¹ demurs to the order *Cryptobranchia*, and sides with Professor Forbes, believing *Argiope* to be a true "brachiferous Pal-liobranch."²

The absence of any notice of the loop of *Argiope*, in the descriptions above referred to, is probably owing to the imperfection of the specimens examined; from its extreme delicacy it is often broken away, both from recent and fossil specimens. The character of the loop and septa approximates this genus to *Thecidea*. Much variation appears to exist in the raised septa or ribs in the interior of the smaller valve, which in the recent *A. decollata* are of almost equal height,³ but in all the fossil forms, attributed to the chalk by M. D'Orbigny, and in the tertiary *A. cistellula*, the central rib alone is prominent, while the others are faintly marked, and even imperceptible in most specimens. Dr. Philippi placed the type of this genus, and some supposed similar recent forms, in the genus *Orthis*, but, as remarked by Professor Forbes, they possess none of the characters of that genus.

¹ King, 'A Monograph of Permian Fossils,' Pal. Soc., p. 81, 1850.

² Since writing the above, my attention has been called by Mr. Woodward to the circumstance, that



some of the minutest specimens of *A. decollata*, brought by Professor Forbes from the Egean Sea, contains the dried remains of the animal: we have examined two specimens in this condition, one of which is represented in the accompanying woodcut. The mantle adheres closely to the shell as in *Terebratula proper*, and is not seen, except as part of the shell; its margin is simple and *not ciliated*: the oral arms and their connecting membrane are very distinct, owing to the colour, which, is darker and redder than that of the shell. The dried

cilia (or *cirri*) present the same glistening appearance as in *Thecidea*. The arms originate as in *Terebratula*, on the anterior side of the mouth, and diverge right and left, parallel with the margin of the shell, but at some little distance from it; when they arrive at the raised septa they turn inwards, forming two lobes on each side of the middle line: the outline of the arms is therefore four lobed, whilst in other recent species, *A. cistellula*, and in the Cretaceous *A. decemcostata*, which has only one septum, there is probably only one lobe to each arm. The cilia are few and thick. The arms are relatively connected, as in *Terebratula*, by a membrane filling up the whole interior space, thus forming an apparatus which forcibly reminds us of the Freshwater Polype *Plumatella*, figured by Mr. Hancock.

The distinguished Malacologist, M. D'Orbigny, appears to have mistaken the brachial disk of *Argiope* and the analogous structure in *Thecidea* for the *mantle*, and has founded upon these genera his order *Cirrhidæ*, into which he has admitted, in his most recent publications, the genera *Hippurites* and *Sphaerulites*, and those species of *Diceras* which have one valve smaller than the other.

From the peculiarity of structure above described, we regard *Argiope* as generically distinct from *Terebratula*, but belonging essentially to the same family.

³ For the sake of reference, we have given figures of the interior of the smaller valve of the recent *Argiope decollata* in Part II, pl. iii, figs. 15, 16, but in which the loop is not introduced.

Ter. lunifera and *seminulum* of Philippi¹ have been referred by some authors to this genus, but I have been able to convince myself, from a perfect specimen of the last-named species, that its internal arrangements are completely dissimilar to those seen in the smaller valve of *Argiope*.

The genus *Argiope* seems to have originated, as far as our present knowledge goes, in the cretaceous period, and has continued to our day, one of the species, *A. cistellula*, from the crag being likewise found recent.

4. ARGIOPE CISTELLULA, *S. Wood*. Plate I, fig. 13^{a b}.

TEREBRATULA CISTELLULA, *S. Wood*. 1840. Catal. of Crag Shells, Ann. and Mag. of Nat. Hist., vol. v, p. 253.

MEGATHIRIS CISTELLULA, *Forbes and Hanley*. History of British Mollusca, pl. lvii, fig. 9, 1849.

Diagnosis. Shell inequivalved, variable in shape, wider than long or otherwise, in contour hemispherical or transversely suborbicular, more or less truncated above. Larger valve more convex than the smaller one, in which a longitudinal, central depression is visible, beginning at a short distance from the umbo, and extending to the front. Beak produced, with depressed triangular area; foramen very large, chiefly formed out of the beak and area of larger valve, and completed by the hinge margin of smaller valve; no visible deltideal plates, a small groove only extending from the beak, along the edge of the foramen. Hinge line straight, the central retrusion of the opposite margin shallow, but distinct. The teeth and condyles on either valve are widely separated, owing to the dimensions of the foramen. In the interior of smaller valve, a central septum proceeds from under the crura, becoming gradually more elevated as it approaches the front, where it forms an elevated central, longitudinal plate, dividing the valve, on either side of which are seen two slightly curved lateral elevations, not projecting much above the surface. In larger valve, a slightly elevated longitudinal ridge is visible, extending from under the beak to within a third of the length of the valve; the interior and exterior of valves are strongly punctuated; often having the appearance of raised tubercles, the inner edge being more or less thickened and radiatingly scabrous. Surface smooth, with only a few concentric lines of growth. The colour is of a light, tawny yellow. Length 1, width 1, depth a little more than half a line. *Recent and Fossil.*

Obs. The first discovery of this curious little Brachiopod is due to Mr. S. Wood, who mentioned it under the name of *Ter. cistellula*, in his 'Catalogue of the Crag Mollusca,' published in 1840, several specimens of which he had found in the Coralline Crag of Sutton. Professor Forbes gives a good description of this shell, as found in the recent state, in his valuable work on 'British Mollusca.' We there find stated, that a few specimens had been found in forty fathoms of water by Mr. Jeffreys and Mr. Barlee, while

¹ 'Enumeratio Moluscorum Siciliæ,' pl. vi, figs. 15, 16, 1836.

dredging off Skye; also in thirty fathoms off Croulin Island, near Skye, by Mr. M'Andrew;¹ and lately at the Haaf, or deep-water fishing-grounds of Zetland, by Mr. Barlee. It may be said to be one of our rarest little Brachiopoda, both in the recent and fossil states.

Plate I, fig. 2, one of the recent shapes of this shell.

„ fig. 2^a, enlarged figure.

„ fig. 13, nat. size of the Crag specimens, from Mr. J. Wood's collection.

„ fig. 13^{a b c d}, enlarged illustrations.

Genus—TEREBRATULINA, *D'Orbigny*. 1847.

Shell inequivalve, ovate, circular or irregularly pentagonal, variable at different stages of growth. Valves convex or depressed; beak more or less produced, and obliquely truncated by the foramen which is excavated out of the substance of the beak, completed by the umbo and by two small rudimentary, lateral, obsolete, deltideal projections, no area or distinct lateral ridges; the smaller valve deepest at the umbo, with two more or less developed auricle expansions. Structure punctuated; surface either minutely striated, plaited, or costellated, articulating by the means of two teeth in the larger, and corresponding sockets in the smaller valve. Apophysary skeleton short, not exceeding a third of the length of the shell, and formed of two short stems, simply attached to the extremity of the socket ridges, which, after converging, are united by a lamella, in the shape of a small, square, tubular ring, bent upwards in front, to the sides of which are fixed the free fleshy arms of the animal, these extending to near the front margin, bent back in the shape of a loop, the outer edges being covered by long cirri; body of the animal small, the edges of the mantle free, pedicule muscles very short; dimensions rarely exceeding one inch and a half.

Obs. The separation of the shells forming this genus from *Terebratula* is due to M. D'Orbigny, who pointed out the difference of their respective apophysary skeletons. We differ, however, from that author, when stating that this genus is deprived of deltidium; it generally is rudimentary, small, and lateral, but in some species, as in *T. substriata* of Schlotheim, the deltidium is large and almost complete. M. D'Orbigny is likewise in error in the statement, in his 'Pal. Française Ter. Crétacés,' vol. iv, p. 58, that the genus *Terebratulina* appeared for the first time in the Cretaceous period. I am perfectly well acquainted with two forms of the genus in the Oolitic period, one of which is the *Terebratulina substriata* of Schlotheim, placed by M. D'Orbigny² among the *Terebratulæ*.

¹ These specimens have been presented by Mr. M'Andrew to the Museum of Practical Geology, where they were pointed out to me by Professor Forbes; in size and shape they quite agree with those from the Crag.

² 'Prodrome,' vol. ii, p. 24, 1850. (This species belongs to the *Cor. Rag*: has been figured by Zieten in 1832, under the name of *T. striatula*. It is not the same as Sowerby's or Dr. Mantell's species, bearing that appellation.)

T. substriata has all the characters of the genus under notice, its apophysis being annular, and entirely similar to that of the type species *Terebratulina caput serpentis*. In the Cretaceous period this genus appears to have most abounded, and has lived through the Tertiary period up to the present day. It is found recent in many localities.

5. *TEREBRATULINA CAPUT-SERPENTIS*, *Linnæus*, Sp. Plate I, figs. 3, 4, 5, 6 (recent); 14, 15 (fossil).

- ANOMIA CAPUT-SERPENTIS*, *Linn.* Syst. Nat., 12 (non ed. 10), p. 1153; Fauna Suecica, ed. 2, p. 521; Acta Upsaliens, 1773, vol. i, p. 41, pl. 5, fig. 3.
- — *Born.* Mus. Cæs. Vind., p. 119.
- — *Chinn.* Conch. Cab., vol. viii, p. 103, pl. lxxviii, fig. 712, 1785.
- — *Dillw.* Recent Shells, vol. i, p. 293; Index Testaceolog., pl. ii, fig. 22.
- *RETUSA*, *Linn.* Syst. Nat., ed. 12, p. 1151; Fauna Suecica, ed. 2, p. 521.
- — *Dillw.* Recent Shells, vol. i, p. 292.
- *PUBESCENS*, *Linn.* Syst. Nat., ed. 12, p. 1153.
- ANOMIA PUBESCENS*, *Schröter.* Eintest. Conch., vol. iii, p. 397, pl. ix, fig. 10.
- — *Dillw.* Recent Shells, vol. i, p. 293; Index Testaceolog., pl. ii, fig. 20.
- TEREBRATULA PUBESCENS*, *Müller.* Zool. Danic Prodomus, p. 449, No. 3007.
- *CAPUT-SERPENTIS*, *Lam.* (non *Retzius.*) Anim. sans Vert. (ed. Desh.) vol. vii, p. 332.
- — *Sow.* Gen. of Shells, Tereb., fig. 2.
- — *Philippi.* Moll. Sicil., vol. i, p. 95, pl. vi, fig. 5; and vol. ii, p. 66.
- — *Reeve.* Conch. Systemat., pl. cxxvi, fig. 2.
- — *Sow.* Thesaurus Conch., vol. i, pl. lxviii, figs. 1—4; and pl. lxxii, fig. 116.
- — *Forbes and Hanley.* British Mollusca, pl. lvi, figs. 1—4.
- *COSTATA*, *Lowe.* Zoologic. Journal, vol. ii, p. 105, pl. i, fig. 89.
- *AURITA*, *Fleming.* Phil. Zool., vol. ii, p. 498, pl. iv, fig. 5; British Animals, p. 369; British Marine Conch., p. 127.
- — *Brown.* Illust. Conch. G. B., p. 68.
- *GREVILLEI*, *S. Wood.* Cat. of Crag Shells, Mag. Nat. Hist., vol. v, p. 253, Dec., 1840.
- TEREBRATULINA CAPUT-SERPENTIS*, *D'Orbigny.* 1847. Comptes Rendus de l'Académie des Sciences et Pal. Franç. Ter. Crétacés, vol. iv, p. 58.

Diagnosis. Shell ovate, rounded or pentagonal, longer than wide, variable in appearance at different ages; valves almost equally convex, beak produced and obliquely truncated by a moderately sized foramen, principally excavated out of the substance of the beak, completed by the umbo and by two small, rudimentary, lateral, deltideal plates; no distinct cardinal area or beak ridges; smaller valve convex, with two more or less developed auricles, much expanded in the young, smaller and more oblique in the adult

state, where they sometimes almost disappear from the regular convexity of the valve; margin flexuous; in the young the valves are less convex. Imperforated valve deepest near the umbo, forming at times a rounded, elevated ridge, extending to the front, a corresponding depression or shallow sinus existing in the larger valve; while, in other specimens, a mesial longitudinal depression exists in the smaller valve.

The surface is ornamented by a great number of radiating little ribs or costæ, fewer, coarser, and simple in the young, augmenting rapidly in number at a more advanced period by bifurcation, and by the intercalation of a number of small plaits, intersected by regular concentric striæ, strongly produced in young specimens, giving the shell a granulated appearance, these becoming less distinct as the animal advances in age. The internal calcareous supports in smaller valve short and anneliform; the muscular impressions are marked; no mesial longitudinal septum is perceptible on either valve; their internal edges minutely crenulated; structure punctuated; colour squalid white. Dimensions variable: length 11, width 7, depth 5 lines.

Recent and Fossil.

Obs. This species of shell and its animal has been ably described by Professor Forbes in his work on 'British Mollusca:' "The arms or buccal appendages occupy the greater part of the cavity of the shell. They are fixed to and follow the course of the apophysary skeleton, and appear when the shell is forcibly opened in the form of a pair of brilliant orange or crimson fringed loops, lodged in each half of the cavity of the imperforated valve; the outer margins of each loop bear long cirrhi, also of a brilliant orange or crimson hue, and though the arms themselves cannot be protruded, their cirrhi are very extensile: when the animal is lively, the two valves separate and gape, for no very great distance from each other in front, and from their sides are seen the long crimson cirrhi, extended like a pair of double fringes, and borne somewhat stiffly, and with a slight curve outwards. Towards the edge of the strongly adherent mantle attached to each valve, are placed at regular intervals about forty small cirrhi of a softer texture, which do not appear to be protruded, at least conspicuously, beyond the edges of the shell: these cirrhi are tinged with crimson; also at their bases are seen, when a high magnifying power is used, coloured dots and cavities with vibrating corpuscles, which may be regarded as ocelli, and otilitic capsules. The whole surface of the mantle is studded with vibratile cilia. On each side of the inner surface of the perforated valve is seen an ovarium of an oblong shape and brilliant vermilion colour; and extending beyond these ovaria, in radiating fashion, are the glandular masses of the liver."

In the recent state it is one of our commonest Brachiopoda, first found by Dr. Fleming at Ullapool in Loch Broom, afterwards dredged by different collectors at Oban; on the West Coast of Scotland, Loch Fyne; at Lismore, near Oban, off Armadale, in the Sound of Skye, forty miles West of Zetland, &c., in depths varying from ten to fifty fathoms. It is likewise found in many spots throughout European seas, presenting slight variations in different localities. In the fossil state, it occurs in the Coralline Crag of Sutton, where

Mr. S. Wood discovered a few young specimens, noticed in his Catalogue under the name of *T. gervillei*? The question now is, whether *T. caput serpentis* really occurs lower down in the series, as some persons seem disposed to believe, from similarly shaped shells being found in almost all the series of tertiary deposits, as well as in those of the cretaceous period. We have compared with great care a number of these, and must confess that, in many cases, the variations are so trifling, that we find them in general reproduced on various specimens of the living type. It is only on adult shells, where all the characters are developed, that a positive determination as to specific difference can be established, great similarity existing in the young state of this genus. We believe, however, that there are some differences, which, though slight, may allow us perhaps to establish a few species and varieties, although we do not consider the subject as yet satisfactorily decided. Professor Forbes, in whose judgment I have great confidence, inclines to believe, that the recent type is really found lower down, both in the tertiary and cretaceous period, but for the present I have been unable to satisfy myself that such is truly the case, although it may be so. It is, however, certain, that too many species have been proposed in the genus, which will be referred to in their proper places.

6. *TEREBRATULINA STRIATULA*, Sow., Sp. Plate I, figs. 16, 16^{a b}.

TEREBRATULA STRIATULA, Sow. (Partim non *T. striatula*, Mantell,) 1829, vol. vi,
p. 69, tab. 536, fig. 5, non figs. 3, 4.

— — *Morris*. (Partim) 1843. Catalogue.

Diagnosis. Shell of a rounded oval or irregularly pentagonal shape, longer than wide; valves convex and compressed; beak not much produced, truncated by a moderately sized foramen, principally excavated out of the substance of the beak, and completed by the umbo and two small lateral obsolete deltideal plates; no distinct area or beak ridges; hinge lines circular; auricles small, often almost indistinct; valves ornamented by a great variety of minute striæ or costæ of unequal width, sometimes bifurcating, but more often augmenting by the intercallation of smaller costæ appearing at different distances from the umbo and beak, and extending to the front. Margin line slightly flexuous. Loop short, anneliform. Length 10, width 8, depth 4 lines.

Obs. Although the distinctions between this shell and the recent *caput serpentis* are not very great, still we think them sufficient to authorise its separation. Both young and adult specimens of the recent species just mentioned seem in general more convex, and tapering at the beak than in the London clay species, which is wider and more circular at the beak, the valves being likewise much more compressed, and the margin line less sinuous, nor do we find that mesial longitudinal depression so often visible in the cretaceous *T. striata*; the striæ which ornament the valves is so variable in number, as well as in dimensions, that they cannot serve as a distinguishing character; they increase in number rapidly at a short distance from the beak and umbo, much more by intercalation than

bifurcation, smaller plaits appearing between the principal costæ, which lying often close to the original ones at their origin, give a false appearance of bifurcation; and draw so near to each other at the margin, that seven or eight may be counted in the breadth of a line, eighty or ninety ornamenting each valve.

This shell is found in the London clay; the largest specimens I have seen, 10 lines in length, were procured by Mr. Bowerbank from the London clay of Sheppey; it has likewise been met with in other localities.¹

I have felt embarrassed to decide which name this species should retain, being aware that the term *striatula* had been applied by Dr. Mantell, in 1822, to a cretaceous species,² but which name was however only a synonym, the shell having received that of *striata*, in 1821, from Wahleberg.³ Subsequently Sowerby, as well as many other authors, indiscriminately adopted Dr. Mantell's name, both for the cretaceous and the species under consideration; I have therefore thought it advisable, to avoid a new name, to adopt that of *striatula* exclusively for the Tertiary species, and retaining that of *striata* for the Chalk shell. We may likewise observe, that from the description and figures given by Mr. Morton,⁴ of his *Ter. lacryma*, we should conclude our London clay species distinct from the American one.

Fig. 16. Specimen from the London clay of Sheppey, in the collection of Mr. Bowerbank.

16^a. An enlarged illustration.

Genus—TEREBRATULA, *Lhwyd*. 1699.⁵

Shell inequivalve, equilateral, elongated, transverse or circular; exterior smooth, rarely striated or plaited; valves generally convex, with or without sinus, corresponding to a mesial fold in smaller valve. Front straight or sinuated: beak always truncated by an apical, emarginate, or entire foramen; deltideum in one or two pieces; internal ribbon-shaped lamella (partly supporting the ciliated arms), attached only to the crura, short or elongated, and more or less folded back on itself; animal fixed to submarine bodies, by muscular fibres passing through the foramen; structure perforated.⁶

¹ M. Deshayes has, within the last few years, found, in the Calcaire Grossier of the neighbourhood of Paris, young specimens of a shell, which is probably the same as our British species; but, from the great similarity presented by specimens at that age, it is very difficult to decide as to identity.

² 'Geol. of Sussex,' pl. xxv, figs. 7, 8, 12.

³ 'Wahleberg Petref.,' pl. vi, 1821.

⁴ J. S. Morton, 'Synopsis of the Organic Remains of the Cretaceous Group of the United States,' pl. xvi, fig. 6; and pl. x, fig. 11. According to Sir C. Lyell, Viscomte D'Archiac, and M. D'Orbigny, *T. lacryma* would belong to the age of the London Clay; and it is placed by M. D'Orbigny in his 'Terrain Parisien Prodrome,' vol. ii, p. 396.

⁵ 'Lithophylaci Britannici Ichnographia.' London, 1699.

⁶ See Introduction, and Part III, p. 26.

Obs. We are only acquainted with one species of British recent *Terebratula*, and two from the supercretaceous period.¹

7. *TEREBRATULA GRANDIS*, *Blumenbach*. Plate I, fig. 18, Plate II, figs. 1—8.

TEREBRATULITES GRANDIS, *Blumenbach*. 1803. Specimen Archæologiæ Telluris Terrarumque Imprimis Hannoveranarum, Tab. I, fig. 4; figured, but not named, likewise by Knorr, in 1755. *Lapides Deluvii Universalis Testes*, Tab. B iv, figs. 1 and 2; reproduced by Walsh and Knorr in 1768. *Die Naturgeschichte der Verst*, Tab. B iv, figs. 1, 2; also *Ency. Meth.*, pl. 239, fig. 2.

TEREBRATULITES GIGANTEUS, *Schl.* 1813. Beiträge Zur Natur. der vers in Leonhard's Mineral Tasch., vol. vii.

— — *Schl.* 1820. Die Petrefactenkunde, p. 278, No. 48.

TEREBRATULA VARIABILIS, *Sow.* M. C., vol. vi, p. 148, Tab. D lxxvi, figs. 2—5, 1829.

— *GIGANTEA*, *V. Buch*. 1838. Mém. de la Soc. Géol. de France, vol. iii, 1 ser., p. 222, (non pl. xx, fig. 3, which is *Ter. bisinuata*, Lamarck.)

— *VARIABILIS*, *Galeotti*. 1837. Mémoir sur la Const. Géol. du Brabant, p. 151.

— — *Nyst and Westendorp*, 1839. Nouv. Rech. sur les Coquilles Fossil de la Province d'Anvers, p. 15, No. 37.

— *MAXIMA*, *Charlesworth*. 1837, Mag. Nat. Hist., p. 92, figs. 13, 14.

SOWERBII, *Nyst*. 1843. Coq. et Polyp. de la Belgique, p. 335, pl. xxvii, fig. 3 a, b.

— *VARIABILIS*, *Morris*. 1843. Catalogue.

— — *Tennant*. A Stratigraphical List of Brit. Fos., p. 17, 1847.

— *GRANDIS*, *Bronn*. 1848. Index Palæontologie, p. 1237.

— *VARIABILIS*, *Brown*. 1838. Illust. of Foss. Conch. of Great Britain, pl. liv, figs. 16, 19, 21, 22.

WALDHEIMIA VARIABILIS, *King*. 1850. A Monograph of Permian Fossils, p. 60.

Diagnosis. Shell inequivalved, variable in form, oval, more or less orbicular, generally longer than wide; valves almost equally convex; beak produced, not much recurved, and obliquely truncated by a large circular foramen, separated from the umbo by a narrow, cicatrised, concave deltideum, disunited in the young age; beak ridges indistinct; smaller valve regularly convex, two undefined, slightly elevated plaits existing towards the frontal

¹ The discovery of this species, *Terebratula cranium*, as a British Shell, is due to Dr. Fleming, who obtained three specimens in deep water to the Eastward of Bressay, in Zetland. It is found also on the Coast of Norway and in the Northern Seas. It has been well described and figured by Professor Forbes, G. B. Sowerby, and by Colonel Montague, in the eleventh volume of the 'Linnean Transactions,' &c. It has not been noticed in the fossil state; and, as stated by Sowerby, is well distinguished from *Ter. vitrea* by the greater length of its loop. Plate I, figs. 8, 8^a b.

edge in adult specimens; larger valve convex, with two shallow sinuses corresponding to the buplications of the imperforated valve; margin line slightly sinuated; surface of valves smooth, marked only by a few concentric lines of growth; loop in smaller valve short, attached only to the crura, and extending to about a third of the length of the valve; teeth of larger valve very strong, the posterior portion of the valve near the beak very thick in adult shells; structure punctuated; length four inches two lines, width three inches, depth two inches.

Obs. On examining the figures given by Blumenbach in 1803, as well as those before him, by Knorr and Walsh in 1756 and 1768, there seems to be little doubt that the shell under notice belongs to the first named author's *Terebratula grandis*, these views being likewise admitted by Professor Bronn and others; subsequently Schlotheim (1813) gave to this shell the name of *giganteus*, while acknowledging it to be the same as Blumenbach's species, referring to his work and figure. Baron von Buch adopts this last author's name, giving as synonyms, *T. bisinuata*, Lamarck, and *T. variabilis*, Sow. (the figure of the specimens inserted in the Mém. de la Soc. Géol. de France are those of the Lamarckian species, and not *grandis* of Blumenbach), but both Baron von Buch and Professor Bronn place under the same name shells, in my opinion, quite distinct, such as *T. bisinuata*, Lam., *Fragilis* of Koenig, which certainly do not belong to the type of *T. grandis*; the shell of *T. bisinuata* being very thin and brittle, as Koenig's name expresses, while that of the crag is very thick and strong, besides differing by various other characters of shape. In 1829 it was described and figured by Sowerby in the Min. Conch., under the name of *T. variabilis*, which name has been in general use in England. Mr. Nyst (in 1843) rejects Mr. Sowerby's name, on account of a similar denomination having been given by Schlotheim in 1813 to a plaited Lias Terebratula,¹ and proposes in lieu that of *T. Sowerbii*. Mr. Charlesworth advocated likewise in 1837, the name of *T. maxima* as a substitute for *variabilis*, but as we have stated above, we cannot but believe it must be the same as that figured by Blumenbach in 1803; the figure representing a large Terebratula measuring two inches nine lines in length, and two inches one line in breadth, and in every respect identical in shape to many of our crag specimens, which are, as Sowerby's name expresses, very variable in form, some being almost circular, others oval, and even considerably elongated, convex, or depressed, regularly rounded, or with a slight buplication in front. Mr. S. Wood having been able to trace specimens from less than a line in length to the largest dimensions, much confusion has arisen from the desire of some authors to combine, under one name, some strongly buplicated forms, such as *Ter. ampulla* of Brocchi, *T. bisinuata*, and *Pedemontana* of Lamarck, thus extending beyond reasonable limits the characters assignable to the type form. The best figures of this species, as found in England, are those given by Mr. Charlesworth; that author, besides transcribing many interesting details on the species, adds that, "during the early

¹ Schlotheim's *Ter. variabilis* is a true *Rhynchonella*, and therefore does not belong to the Terebratula, properly so called.

stages of growth, the edges of the valves do not encroach upon one another, there being simple adaptation of the margins in an even line from the excessive thinness of the shell at the line of junction; when, however, the shell has attained the length of three inches, the front edge is rather suddenly produced with an abrupt termination, which is received in a notch in the opposite valve."¹ The foramen is also variable in dimensions, sometimes so large as almost to admit the tip of the small finger, being doubtless the largest *Terebratula* as yet come under our notice. The internal apophysary skeleton is short,² never exceeding a third of the length of the valve; we therefore are at a loss to make out why this shell is announced by Professor King³ as an illustration of his genus *Waldhemia*, where, according to that author, the process extends to near the frontal margin.

In England this species is common to both the *red* and *coralline crags*, but larger and more abundant in the last, where it is found in great numbers at Sudbourn, near Orford, on the estate of the Marquis of Hertford, and of the road leading from Aldborough to Leiston. In the red crag the specimens rarely have the two valves united, and are in general much water-worn, the best localities being Sutton, Walton on the Naze, Ramsholt, Felixtow, &c. On the continent it has been met with in several localities by Mr. Nyst, at Pellenberg near Louvain, and in the Crag of Antwerp in Belgium. In France it is stated to have been found à la Gresille near Doué; and during a late journey to Valogne, M. de Gerville showed me a basketful he had obtained from Bohon in the Dep. de la Manche. Blumenbach's types were obtained from Osnabruck.⁴

Plate I, fig. 18. A specimen from the Red Crag, in the collection of Mr. S. Wood.

„ II, fig. 1. Illustrates a remarkably fine specimen in the Museum of Mr. Bowerbank.

„ fig. 2. Interior of the large valve.

„ fig. 3. Interior of smaller valve, showing the loop, which, though incomplete, did not extend to a greater length, from a specimen in the collection of M. Bouchard.

„ figs. 4, 5, 6, 7. Different ages.

„ fig. 8. Enlarged portion of the beak from a young shell, showing that at a certain age the deltideum was only lateral.

¹ 'Mag. of Nat. Hist.,' vol. i, 1837.

² From the coarseness of the sand which fills the interior, it has been as yet impossible to clear the apophysis completely; but, from a specimen in M. Bouchard's collection, it evidently does not exceed the dimensions stated.

³ 'A Monograph of Permian Fossils,' Pal. Soc., p. 69.

⁴ There appears to be a difference of opinion as to the age of this deposit; De Münster places it in the *older Pliocene*, while Goldfuss considers them *Miocene*, or *middle Tertiary*. See M. le Viscomte D'Archiac's valuable notes on this subject, 'Histoire des Progrès de la Géologie,' vol. ii, 2d part, p. 849, 1849.

8. TEREBRATULA BISINUATA? *Lamarck*. Plate I, fig. 17.

TEREBRATULA BISINUATA, *Lamarck*. 1819. An. Sans Vert., vol. vi, p. 252, No. 32;
and Davidson, Notes on an Examination of Lamarck's
Species of Foss. Ter., Annals and Mag. of Nat. Hist., 2d
ser., vol. v, No. 32, pl. xiii, fig. 32.

— — *Deshayes*. Coq. Foss. des Env. de Paris, tom. i, p. 65.

— FRAGILIS, *Kœnig*. 1825. Icones Sect., No. 45.

— GIGANTEA, *V. Buch*. 1838. Mém. de la Soc. Géol. de France, vol. iii,
p. 222, pl. xx, fig. 3. (non *T. gigantea*, Schl.)

— GRANDIS, *Bronn*. 1848. Index Pal., vol. ii, p. 1237. (non *T. grandis*,
Blum.)

— BISINUATA, *D'Orb*. Prodrome, 1849, vol. ii, p. 395.

— — *D'Archiac*. Hist. des Prog. de la Géol., vol. iii, p. 276.

Diagnosis. Shell ovate, longer than wide; large valve convex, longitudinally keeled, a slight lateral depression causing the valve to project more in that part; beak nearly straight, and obliquely truncated by a large foramen separated from the umbo by two small deltideal plates; surface smooth, marked only by a few concentric lines of growth: length twenty-two, breadth nineteen lines.

Obs. The discovery of this *Terebratula* in our lower tertiary deposits is due to Mr. Prestwich, who unfortunately found only the larger valve in the Bracklesham sands, now considered to be the equivalent of the lower beds of the Calcaire Grossier of France, where this same species has been found at Grignon, Parnes, Chaumont, Courtagnon, Mouchi, &c. We cannot, however, help stating that our determination of this shell is not as satisfactory as we might have wished from the imperfect state of the specimen; this seems a rather thicker shell than the French *T. bisinuata*, the foramen is larger, and the deltideum more concave, and it *much* resembles a shell found in more recent tertiary formations in Sicily. It is to be hoped that future researches in the Bracklesham sands may bring to light a more complete specimen.¹

Plate I, fig. 17^{a b}. Specimen from the collection of Mr. Morris.

¹ Since writing the above, and after my plate was printed, Mr. Cunningham, of Devizes, was so fortunate as to discover another and more complete specimen than the one described above. Mr. Cunningham's specimen is smaller, much compressed by pressure, but with both valves; it is circular, rather longer than wide, very thin, not much convex, and presenting *scarcely* any trace of the bisinuation,—a characteristic of the Lamarckian type, but which is not always distinctly visible on the Grignon specimens; and I think we may consider our determination as probable, if not certain. Mr. Cunningham's specimen is from the London Clay of Barton or Hordwell Cliffs, on the Hampshire coast. It measures in length $13\frac{1}{2}$; in width 12 lines.

Genus—*RHYNCHONELLA*, *Fischer*. 1809.

Shell more or less circular, elongated or transverse; valves convex; beak acute, slightly or greatly recurved; no true area; peduncular perforation variable in form; entirely or partially surrounded by a deltideum, either lateral and rudimentary, complete, or tubular. Surface of valves variously ornamented, rarely smooth, generally striated, plaited, or costellated; structure non-punctuated, divisible into laminæ of extreme tenuity; valves articulating by means of two teeth in larger, and corresponding sockets in the imperforated valve; apophyses in smaller valve consisting of two short lamellæ, separate and moderately curved upwards, flattened and grooved, to which are attached the free, fleshy, spiral arms.

Obs. We consider M. D'Orbigny's lately proposed genus *Hemithiris* as synonymous with that established by Mr Fischer in 1809, under the name of *Rhynchonella*, both genera being made up of shells of the same form, structure, apophysis, muscular impressions, &c.; the only distinction, according to M. D'Orbigny, consisting in the erroneous statement, that the foramen in *Hemithiris* was deprived of deltideum; while, in *Rhynchonella*, it was complete and tubular.

If we now examine with care some of M. D'Orbigny's types of *Hemithiris*, such as *H. psittacea* and *spinosa*,¹ we find that, in the first, the socket-walls do not form simply the sides of foramen, but that there exist two narrow plates, gradually widening as they proceed from the extremity of the beak and overlaying the socket walls, as we see in many species, considered to be possessed of deltideum. In the second, *H. spinosa*, D'Orb., we find regular lateral, deltideal plates, which do not completely surround the foramen, and this becomes evident in specimens where the beak is not so much recurved as to conceal the aperture. If, on the other hand, we cast our eyes on some of the shells admitted by M. D'Orbigny as true *Rhynchonellas*, the deltideum is found disposed in the following three ways:—

1. Small and lateral, as in *R. concinna*, the foramen not entirely surrounded, a small portion being completed by the umbo.
2. Surrounding the foramen, without tubular expansions, as in *R. obsoleta*.
3. Surrounding the foramen, thickened and produced in the form of a tubular expansion, as in *R. compressa*, *scaldinensis*, *vespertilio*, &c.

From the above it will be clearly seen that there is no important distinction between the two genera; both, in our opinion, are referable to the genus *Rhynchonella*. These views as to the form and value of the deltideum were published in a paper by M. J. Deslongchamps,² and by Mr. Morris³ some years back. The last-named author,

¹ M. D'Orbigny afterwards placed this shell into his genus *Acanthothiris*.

² Soc. Linnéenne de Normandie, 1837.

³ 'Quarterly Journal of the Geol. Soc.,' vol. ii, Part I, pp. 382-9.

besides admitting the presence of a slightly developed deltideum in *R. psittacea*, places it in the same genus as *R. vespertilio*, only under the generic name of *Hypothyris*, Phillips, not being aware at the time of Fischer's priority of date, his type having been established on *Rhynchonella lowia*, a Russian Oolitic species, somewhat similar in form to our common Lias *R. acuta*, and possessing the essential characters.

9. RHYNCHONELLA PSITTACEA, *Chemnitz*, Sp. Plate I, fig. 7^{a b} recent; fig. 19^{a b}, tertiary.

ANOMIA ROSTRUM-PSITTACI, *Chemnitz*. Conch. Cab., vol. viii, pl. 106, p. 78, fig. 713, 1785.

— PSITTACEA, *Gmelin*. Syst. Naturæ, p. 3348.

— — *Turt.* Conch. Dic., p. 5, figs. 42, 44.

— — *Dillw.* Recent Shells, vol. i, p. 296; Index Testaceolog., pl. ii, fig. 27.

— — *Mawe.* Linn. Conch., pl. xv, fig. 3.

LAMPAS PSITTACEA, *Humphrey*. Museum Calonnianum, p. 834, 1797.¹

TEREBRATULA PSITTACEA, *Lamarck*. An. sans Vert., vol. vi, 1819.

— — *Turt.* Dithyra Brit., p. 336.

— — *Fleming.* Brit. Animals, p. 368.

— — *Thompson.* Ann. Nat. Hist., vol. xiii, p. 433; Brit. Marine Conch., p. 127.

— — *Brown.* Illust. Conch. G. B., pl. lxiii and pl. xlvi, figs. 2, 3, 4.

— — *Alder.* Cat. Moll. Northumberland and Durham, p. 74.

— — *Crouch.* Introd. Lam. Conch, pl. xiii, fig. 4.

— — *Sow.* Genera Shells, Terebratula, fig. 5; Thesaurus Conch., vol. i, p. 342, pl. lxxi, figs. 78—80.

— — *Sow.* (jun.) Conch. Manual, p. 202.

— — *Gould.* Invert. Massach., pl. 142, fig. 91.

— — *Reeve.* Conch. Systemat., pl. 126, fig. 5.

— — *Forbes and Hanley.* British Mollusca, pl. lvii, figs. 1—3.

— — *Forbes.* Mem. Geol. Survey, vol. i, p. 407.

— — *Morris.* Catal. of Br. Fossils. 1843.

— — *Lyell.* Geol. Proc., vol. iii, p. 119; Encyc. Meth., p. 224, fig. 3.

— — *Bronn.* Index Pal., vol. ii, p. 1247.

— — *Tennant.* Strat. List of Brit. Fossils, p. 17, 1847.

HYPOTHYRIS PSITTACEA, *King*. Annals Nat. Hist., vol. xviii, p. 238; and Monograph of the Permian Fossils of England, p. 65, 1850.

— — *Morris.* Quart. Journal of the Geol. Soc., vol. ii, pp. 382—9.

¹ In 1797, Humphrey proposed the Genus *Lampas*, in which he places the following species:—*L. columbina* (*Anomia terebratula*, Linn.), *L. truncata*, *L. pectiniformis*, *L. psittacea*, *L. caput-serpentis*, and *L. sanguinea*. This genus, which has been adopted by no one that I am aware of but Mr. Gray, in the Coll. of Br. Mus., is composed of a number of species, all of which have since been placed in separate genera. In 1767, Davila ('Catal. Syst. et Raisonné des Cur. de la Nature') gives two very good figures, pl. xx, fig. B, of *R. psittacea*, under the name of *Bec de Perroquet*. Lister likewise illustrates this species in Tab. 211, fig. 46, of his 'Hist. sive Synopsis Meth. Conchyliorum,' 1685.

HÉMITHIRIS PSITTACEA, *D'Orb.* Considérations Zoologiques et Géologiques sur les Brach. ; Comptes Rendus de l'Académie des Sciences, 1847 ; et Pal. Franç. Ter. Crétacés, vol. iv, atlas pl. 490, fig. 10

RHYNCHONELLA PSITTACEA, *Woodward.* 1851. Manual of the Mollusca, p. 8.

Diagnosis. Shell of a rounded, somewhat globosely triangular shape, compressed laterally ; smaller valve gibbous, with a slight mesial fold often becoming indistinct by the regular convexity of the valve ; larger valve convex, but less so than the smaller one, with a wide, shallow sinus, beginning at a little distance from the beak, and extending to the front ; beak acuminate, acute and recurved, leaning considerably over the umbo, and perforated by an elongated foramen extending from under the extremity of the beak to the umbo, which completes the circumference, two narrow deltoidal projections laterally edging the aperture. A slight flatness is visible on each side of the beak, the ridges of which are indistinct ; the marginal line of larger valve indents considerably the hinge line of smaller valve near the umbo.

The surface of the valves are ornamented by a great number of closely disposed small striæ, sometimes dichotomising at a short distance from the beak and umbo, also augmenting by the intercallations of smaller costæ, from forty-five to fifty in number on each valve ; besides these, numerous lines of growth intersect the longitudinal striæ. The internal calcareous appendages in the imperforated valve consist of two small curved lamellæ, not exceeding more than one third the length of the shell, to which, in the living state, two free fleshy arms are fixed, and, according to Professor Owen, forming six or seven spiral gyrations, decreasing towards their extremities, which, when completely unfolded, extended beyond the shell to twice its longitudinal diameter. In the interior of the smaller valve a rudimentary septum divides the muscular impressions visible on either side of it. In the larger valve the dental plates are strong, and extend to the bottom of the valve, leaving also between them the corresponding muscular and peduncular impressions. Structure unpunctuated, and formed of minute plates. Colour blackish, and slightly glossy. Length 11 ; breadth 10 ; depth 8 lines.

Obs. This remarkable Brachiopod has been long known, its animal having been well described by Professor Owen.¹ The structure of the shell has likewise been examined microscopically by Dr. Carpenter,² and has been considered a type for the division of the great family of *Terebratulæ* into punctuated and unpunctuated genera. This species is very interesting, inasmuch that it is found recent in our seas, and fossil in our upper tertiary strata. We are indebted to Professor Forbes³ for valuable information relative to its habitat, as found recent on our coasts. He states, that Mr. Maclaurin procured it from the Berwickshire coast ;⁴ also by Laskey, off Aberlady Bay ; and in deep

¹ See Professor Owen's Paper, 'Transactions of the Zool. Soc.,' vol. i, 2d part.

² See Dr. Carpenter's Report, British Association, p. 18, 1844.

³ Forbes and Hanley, 'British Mollusca,' vol. ii, p. 339, &c., 1849.

⁴ Berwickshire Nat. Club, vol. i, p. 213.

seas, by dredging, in the Firth of Forth. Professor King showed me, likewise, some years ago, a valve of this shell, brought up from the depth of thirty fathoms, at a distance of twenty-five miles from the northern coast of Northumberland. It is therefore evident that it occurs at a short distance from our coast in the recent state; nor is there anything extraordinary in this fact, as it is a well-known Boreal shell, found abundantly in the northern seas near Greenland, Norway, Labrador, Melville Islands, &c. In the fossil state, it unquestionably occurs in our newer Pliocene beds or Mammiferous Crag of Bramerton, near Norwich, whence it has been collected by Sir C. Lyell, S. Wood, &c.; and several specimens may be seen in the collections of these gentlemen, as well as in those of Mr. Fitch,¹ Professor Tennant, British Museum, &c. These last are from Postwick. It is stated as occurring in similar beds in Ayrshire.

Fig. 7, 7^{a b}, are recent specimens.

Fig. 19, 19^{a b}, are the Crag specimens.

¹ Mr. Fitch informs me, that *R. psittacea* is found in a Crag containing a mixture of land, fresh water, and marine shells; that Mr. Woodward called it "*T. plicatilis*, and rare," in his 'Geol. of Norfolk;' but that he does not believe it rare, although he has only found two perfect specimens with both valves. Single valves, in a very fragile, imperfect state are not uncommon: in one of Mr. Fitch's specimens, the *deltidium* is distinctly seen.

PLATE I.

RECENT.

- Fig.
1. Crania anomala, *Müller*, nat. size.
1^a. „ „ Attached valve enlarged.
1^b. „ „ Upper valve.
2. Argyope cistellula, *S. Wood*, magnified.
3. Terebratulina caput-serpentis, *Linn.*, sp.
4. „ „ Young specimen, enlarged.
5, 5^a. „ „ Enlarged specimen, to show the intercalated plaits.
6. „ „ Interior of the small valve, showing the short annular process.
7. Rhynchonella psittacea, *Chemnitz*.
7^a. „ „ Smaller valve, showing the short calcareous appendages.
7^b. „ „ Interior of large valve.
8. Terebratula cranium, *Müller*.
8^a. „ „ Interior, exhibiting the loop.

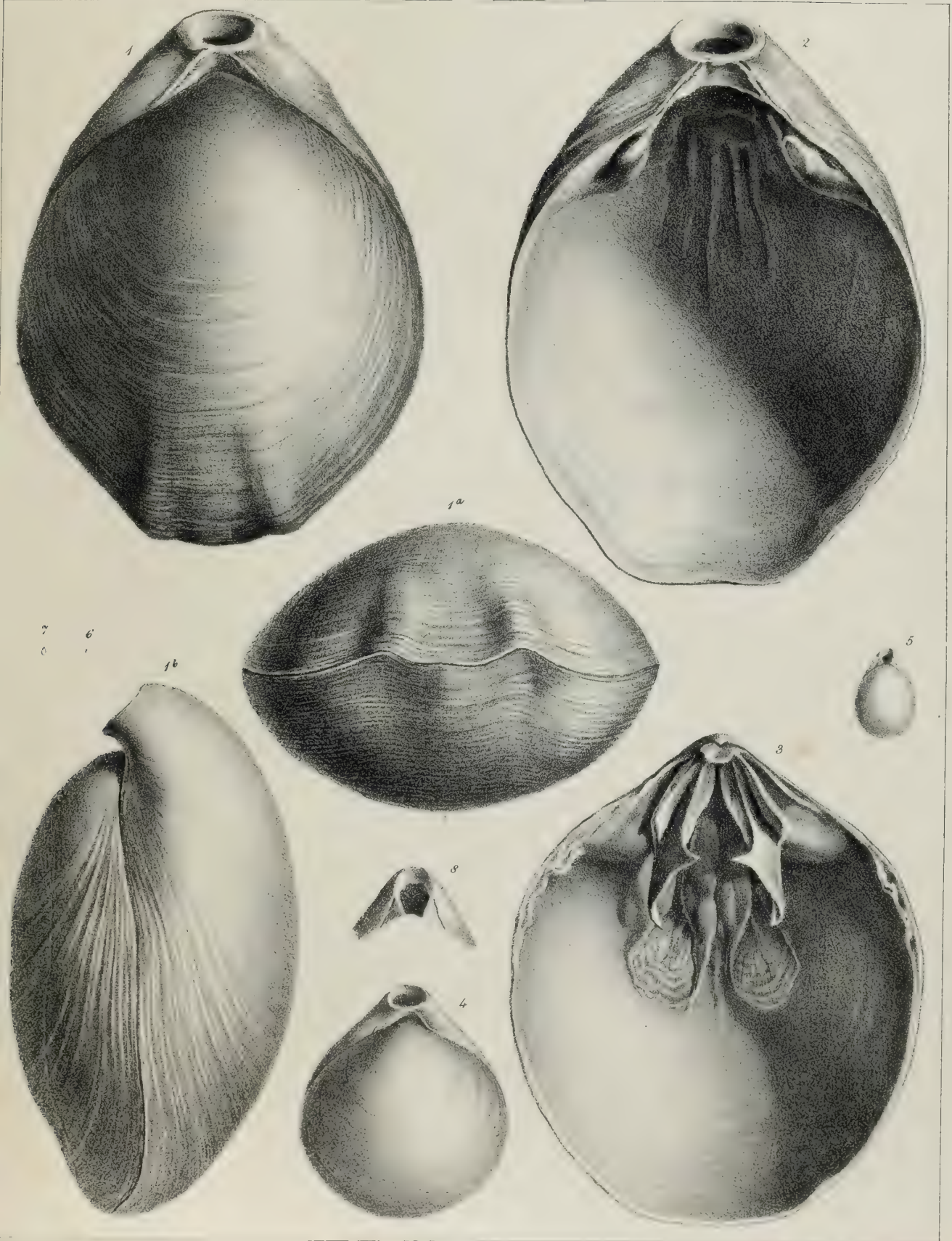
FOSSIL.

9. Orbicula lamellosa? *Brod.*, nat size.
9^{a b}. „ „ Enlarged.
10, 11. Lingula Dumontieri, *Nyst*, two specimens, nat. size.
10^{a b}. „ „ Interior of both valves enlarged.
12. „ tenuis, *Sow.*, nat. size.
13. Argyope cistellula, *S. Wood*, sp., nat. size.
13^{a b}. „ „ Enlarged.
13^c. „ „ Interior of smaller valve.
13^d. „ „ „ of larger valve.
14. Terebratulina, caput-serpentis, young specimen from the Crag.
14^{a b}. „ „ Enlarged.
15. „ „ Young specimen.
15^a. „ „ Enlarged.
16, 16^a. „ striatula, nat. size.
16^b. „ „ Enlarged.
17, 17^{a b}. Terebratula bisinuata? *Lamarck*.
18. „ grandis, *Blumenbach*, from Red Crag.
19^{a b}. Rhynchonella psittacea, *Chemnitz*, sp., from the Crag.



PLATE II.

- Fig.
 1, 1^a, 1^b. *Terebratula grandis*, *Blum.*, from a specimen, in the collection of Mr. Bowerbank,
 Cor. Crag of Sudbourn.
- | | | | |
|----------|---|---|--|
| 2. | „ | „ | Interior of larger valve. |
| 3. | „ | „ | Interior of smaller valve, showing the length of the loop
(not complete). |
| 4. | „ | „ | A circular variety. |
| 5, 6, 7. | „ | „ | Young specimens. |
| 8. | „ | „ | Enlarged beak of fig. 5, showing the disunited deltidium
at that age. |



A MONOGRAPH
OF
BRITISH
CRETACEOUS BRACHIOPODA.

BY
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PART II.

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A MONOGRAPH
OF
BRITISH CRETACEOUS BRACHIOPODA.

PRELIMINARY REMARKS.

IN the present Monograph, our object is to describe those British species of Brachiopoda that lived during the deposition of the widely spread and remarkable accumulation of sediment known under the name of the CRETACEOUS SYSTEM, the stratigraphical position of which is between the lowest Tertiary and uppermost Oolitic deposits.

The great character of the period is well marked by its animal remains, which are abundant and often very perfect, owing to the nature of the sediment in which they were imbedded.

The active researches of a multitude of intelligent observers have shown, that the system in itself is susceptible of being subdivided with advantage into periods of secondary value, but far less important than those distinctions which separate the few great Geological systems. Indeed, in many cases, the lines of demarcation in the subdivisions of a system may be considered more or less arbitrary; forming links merely of a continuous series, as is proved by some of the same species being common to each. These secondary divisions are, however, good and useful as Geological horizons, and in most cases distinguished by a prevalence of certain forms peculiar to each in particular, and having a more or less prolonged existence.¹

In Great Britain the Cretaceous System has a wide range. From Flamborough Head on the Coast of Yorkshire it extends in a South-Easterly direction to the Wash in Lincolnshire: commencing again on the North Coast of Norfolk, it proceeds in a South-West direction, and occupies a considerable portion of the Counties of Norfolk, Suffolk, Cambridge, Hertford, Oxford, Berks, Wilts, and Dorset. From the great central space of

¹ Consult Mr. Barrande's interesting paper on the "Migration of Species," 'Bull. de la Soc. Géol. de France,' vol. viii, 2d series, p. 150, 1851.

Salisbury Plain it takes an Easterly direction, by Andover, Alton, Guildford, Reigate, Wrotham, Rochester to Ramsgate, Deal and Dover, on the East Coast of Kent. In another direction, from Salisbury Plain, it proceeds by Winchester, Arundel, and Lewes, to Brighton, Newhaven, and Beachy Head on the Channel. It also passes through the centre of the Isle of Wight, from the Culver Cliffs and Needles at the Western extremity, occupying a large part of Hampshire, and greater or less portions of Surrey, Sussex, and Kent, by those two Southern divisions of its course. Chalk also occurs in the North of Ireland; but, for further details, we must refer to those excellent Geological works, in which every stratigraphical detail will be found admirably delineated.¹ Therefore we only mention here a few points connected with the distribution of our species.

In Great Britain the Cretaceous System is incomplete: some of the lower beds are wanting, such as the lower *Neocomien* of the French. The total thickness of our beds is supposed to be from 600 to 1000 feet, divided by the generality of British Geologists into six subdivisions, varying more or less in their mineralogical composition, but not all equally well defined by their organic remains; at least so far as Brachiopoda are concerned, as may be observed during the progress of this work. In the *red chalk* of Norfolk three species only have been noticed as yet, one common in the Lower Chalk, the second in the Upper Green Sand and Gault, and the third has not hitherto been discovered in any other British deposit, but is peculiar to the *Tourtia* of Belgium. Geologists seem to consider the *red chalk* to represent the Gault, from its being said to contain other species, such as *Am. dentatus*, *Bel. minimus*, *Inoceramus sulcatus*, and some other forms common to that strata. But few species are found in the *Speeton Clay*, these also occurring in the Upper Green Sand of Cambridge: most Geologists have considered the Speeton Clay as the equivalent of the Gault. We therefore believe it possible that the Upper Green Sand and the Gault are more intimately connected than is generally allowed. In the true Gault, few species are met with; those conjectured from the Gault of Cambridge turn out to be all from the Upper Green Sand.

The age of the Farringdon beds may yet afford a subject of discussion, although several distinguished geologists² state them to be *Lower Green Sand*. All I can say is,

¹ Consult the works of Messrs. Smith, Conybeare, and W. Phillips ('Outlines of the Geology of England and Wales,' 1822); the various papers and works of Dr. Fitton, in the 'Geol. Trans.' and 'Quart. Journ. of the Geol. Soc.,' Professor Phillips ('Geol. of Yorkshire'); Sir H. de la Beche ('On the Chalk and Green Sand of Lyme,' &c.), 'Geol. Trans.,' vol. ii; Dr. Mantell's several works on the 'Geology of Sussex,' in 1822, 1833, and 1844. Also the interesting papers of Professor Forbes, Messrs. E. Bennet, Lonsdale, Rose, Woodward ('Geol. of Norfolk'), Morris, Weaver, Clarke, Bowerbank, Lyell, Ibbetson, Austen, &c. Also the works of many distinguished foreign geologists, such as Viscount d'Archiac, D'Orbigny, Reuss, Rømer, Cuvier, Brongniart, &c. &c.

² Refer to Mr. Austen's paper in the 'Quart. Journ. of the Geol. Soc.,' vol. vi, No. 24, p. 454, 1850; likewise, for the position of the Mans beds, to M. E. Guéranger's interesting section in the 'Bull. Soc. Géol. de France,' vol. vii, 2d ser., p. 800, 1850; also to Viscount d'Archiac's 'Memoir on the Tourtia,' in the 'Mém. de la Soc. Géol. de France,' vol. ii, 2d ser., p. 293, 1837.

that after a careful investigation of the locality, I was unable to convince myself of the real position of these beds. The shells do not appear to have lived on the spot in which they are found; some of the Brachiopoda are undoubtedly found in the *Tourtia*, the *Upper Green Sand*, and the *Lower Green Sand* of many localities. Among these we may mention *Ter. depressa* (Lamarck), a *Tourtia* shell occurring likewise in the *Hils. Cong.* of Essen, at least I have a specimen from the last-named locality, undistinguishable from the *Tourtia* species. *Ter. oblonga* is found at Farringdon, in the Lower Green Sand of Hythe, Maidstone, &c., in the *Hils. Cong.* of Essen, and in the French *Terrain Neocomien*, but Mr. Cunningham has found it also in the Upper Green Sand of Warminster. *Ter. sella* is abundantly distributed in the Lower Green Sand of many localities, and is met with at Warminster in the Upper Green Sand. *R. lata* (Sow.) is likewise common in the same conditions, &c.

It is therefore difficult to decide the question of the age of the Farringdon beds by the Brachiopoda; and I am convinced (notwithstanding M. D'Orbigny's efforts to prove the contrary) that several of the Cretaceous Brachiopoda lived in more than one of his divisions,¹ and consequently were possessed of a much greater vertical range. There is no reason why certain forms that lived while the Lower Green Sand was in progress of deposition, should not have existed also in the Upper Green Sand. All preconceived systematic views should be avoided, and it is advisable in the present state of Palæontology not to imagine that all species were restricted to such narrow limits. The *Tourtia* of Belgium reposes everywhere directly upon the Palæozoic rocks; some consider it a distinct formation in the Cretaceous System. M. D'Orbigny states it to belong to his *étage cénomanien*; M. Dumont supposes it *Neocomien*, and M. de Koninck, from its containing the *Ammonites varians*, and other fossils of the *Craie chloritée*, sup., refers it to that age; and it is perhaps represented in England by the *Chloritic Chalk with green grains at Chard*, the *Upper Green Sand*, and the *red chalk* of Norfolk.

¹ Consult a most interesting paper by M. J. Cornuel, bearing for title 'Catalogue des Coquilles de Mollusques Entomostracés et Foraminifères du Terrain Crétacé inf. de la Haute Marne, avec divers Observations relatives à ce Terrain,' ('Bull. de la Soc. Géol. de France,' vol. viii, 2d ser., p. 430, 1851.)

In page 446, that author states:—"Il est donc constant qu'il y a passage de quelques céphalopodes aussi bien que quelques gastéropodes et lamellibranches, des couches néocomiennes dans le Gault. Cette circonstance n'empêche pas la faune du Gault d'être, dans son ensemble, très distincte de celle du terrain néocomien.

"M. le Dr. Fitton a établi, par la comparaison des fossiles que toutes les couches du grès vert inf. du bassin de Paris y compris le terrain néocomien proprement dit, ne sont autre chose que le *lower Green Sand* d'Angleterre. Ce savant place la limite supérieur du *lower Green Sand* en Angleterre et en France au point où commence le Gault. Il ne peut rester de doute chez nous qu'au sujet des sables et grès jaunâtres et du sable vert (No. 14 et 15 ci-dessus), en ce sens seulement qu'ils paraissent former le passage entre le terrain néocomien et le Gault proprement dit," &c.

BRITISH CRETACEOUS BRACHIOPODA.

The following Table illustrates the principal characters of the Cretaceous System in England, as well as a few of the foreign synonymic appellations.

CRETACEOUS PERIOD OR SYSTEM.	Upper Chalk.	Nearly pure carbonate of lime, and minute fragments of shells and foraminifera, forming a white or yellowish-white, or light grey soft chalk, with horizontal layers of flinty nodules.	Lewisham, Grays, Northfleet, Norwich, Brighton, Dover, &c.	Corresponds to the <i>Craie blanche</i> of the French, the <i>Oberekreide</i> of the Germans, <i>Etage senonien</i> of M. D'Orbigny.
	Lower Chalk, and Chalk Marl.	Harder chalk than the former, almost without flinty nodules, under which a greyish marking chalk and sand, at times indurated.	Near Dover and Folkstone, Hinton, near Cambridge, near Swaffham, Lewes (Sussex), near Norwich, &c.	This is the <i>Untere kreide</i> and <i>Planer</i> of the Germans, the <i>Craie tufean</i> of the French, <i>Etage turo-nien</i> of M. D'Orbigny.
	Chloritic Marl, and Upper Green Sand.	Variable in its composition, a chloritic marl, containing most of the species of the Upper Green Sand, composed of a chalk with green particles, and minute grains of quartz. The Upper Green Sand is made up of a siliceous sand, or a marly calcareous sand, with green grains often consolidated into nodules of chert, and masses of limestone.	Chard, Chardstock, &c. near Warminster, Alton, Petersfield, Cambridge, &c.	This division seems to correspond to the <i>Glauconie crayeuse</i> of the French, the <i>Tourtia</i> of the Belgians, the <i>Green Sand</i> of the Germans, <i>Etage Cénomancien</i> of M. D'Orbigny.
	Red Chalk, Speeton Clay, Gault.	A thin bed of red chalk, coloured by oxide of iron, with minute siliceous grains. The Speeton Clay is also of a grey colour, containing a mixture of Upper Green Sand and Gault species. Dark blue tenacious clay, at times marly, with some concretions.	Hunstanton Cliff, Norfolk, Speeton Cliffs, Yorkshire, Folkstone, Cambridge, Rigmer, &c.	The <i>Gault</i> of the French, <i>Galt</i> of the Germans, <i>Etage Albien</i> of M. D'Orbigny.
	Lower Green Sand.	Chiefly arenaceous deposits, sand with or without green grains, ferruginous sandstones, beds of clayey sand, clay, and bands of limestone known under the name of Kentish rags.	Folkstone, Hythe, Maidstone, Shanklin, and Atherfield, Isle of Wight.	This is said to represent the upper portion of the <i>Terrain neocomien</i> , or <i>Etage Aptien</i> of M. D'Orbigny.

• Perhaps the fossils of the Cretaceous period have attracted more attention than those of any other system; a great many valuable works and memoirs are published on the subject by Sowerby, Römer, Geinitz, Reuss, Nilsson, Wahlenberg, D'Archiac, Brongniart, &c.; but the most complete is undeniably that of M. D'Orbigny's, 'On the Species of France,' although we regret not being always able to coincide in the determinations and observations communicated by that distinguished Palæontologist; our researches, both in the field and in collections at home and abroad, having led us to different results.

Notwithstanding that in some cases we may be mistaken, still our exertions have tended, we hope, to correct various errors prevalent, especially on the continent, where some of our British types are singularly misunderstood by authors who have not had the same advantages as ourselves of comparing their specimens with the original types preserved in this country. It may at the same time be remarked that, from the vast number of individuals obligingly forwarded from all quarters, we have succeeded in tracing some passages of form; and the great confusion in the nomenclature has arisen from describing species on the study of only one or two specimens; indeed, so perplexing are the minute shades that link certain shapes together, that we have often been embarrassed and uncertain where to draw a line of demarcation.

The internal arrangements of the calcareous appendages or muscular impressions are similar in all the individuals of the same species, and although diversified to some extent in different forms of the same genus, these last are sufficiently constant to warrant separation.¹ Our British Cretaceous period is very rich in species of Brachiopoda, but not so much so as in France, from being deficient in certain beds, which are there very prolific in a variety of forms. I am happy to say that among the numerous British specimens kindly lent to me, I have discovered a number of forms found on the continent, but unknown and unpublished in our English catalogues.²

We have admitted twelve genera among our Cretaceous Brachiopoda, viz., *Lingula*, *Crania*, *Thecidea*, *Argiope*, *Magas*, *Terebratella*, *Trigonosemus*, *Terebrirostra*, *Terebratulina*, *Kingina*, *Terebratula*, and *Rhynchonella*, and will elsewhere discuss their respective value and claims as sections in the class of Brachiopoda; they are based on *important internal*

¹ In page 7, Part III, I noticed the absolute necessity of abandoning the use of the terms *dorsal* and *ventral* in the descriptions of Brachiopoda, and proposed the use of other denominations. Since the publication of the above, Professor M'Coy, ('Annals and Mag. of Nat. Hist.,' Nov. 1851, vol. viii, p. 391,) following out these views, proposes to make use of the terms *receiving valve* for the imperforated valve of *Terebratulæ*, &c., and *entering valve* for the opposite one, of which the beak enters into the cavity of the receiving one. I have no objection to the use of these terms in the sense employed by Professor M'Coy, but should have preferred the name *dental valve* for the perforated one, and *socket valve* for the other. The use of two or three terms to designate them will be found of great convenience where the same technical designations must be often repeated.

² I am particularly obliged to Mr. S. Woodward for lending me a numerous suit of sketches of British Cretaceous Brachiopoda, preserved in various cabinets, which enabled me to procure the loan of the original specimens for illustration and description.

differences, proving modifications in the dispositions of the animal relative to the shell. Many persons from not having devoted sufficient attention to these most interesting variations, and from contenting themselves by the superficial observation of some external characters, would place together many animals essentially different in their details, while separating others whose internal organisation is similar; but those who have truly investigated the matter, after long and conscientious observations, all now admit the necessity of subdividing the few families composing the class into a certain number of genera or subgenera.

I regret not having always been able to examine the interior of the species, and therefore remain in some cases uncertain in which section such forms should be placed.¹

Genus—LINGULA, *Bruguère*. 1789.

Shell inequivalved, one valve more convex than the other, more or less oval, elongated, tapering at the beaks, widened at its pallear region; without hinge, valves held together by the adductor muscles; attached to submarine bodies by a long muscular pedicle issuing between the beaks; a groove, existing for its passage in that of larger valve; arms fleshy, without any calcareous support; structure horny, covered by an epidermis; two muscular impressions in the one, and four in the other valve.

1. LINGULA TRUNCATA, *Sow.* Plate I, figs. 27, 28, and 31.

LINGULA TRUNCATA, *Sow. in Fitton.* Observations on some of the Strata below the Chalk, read before the Geol. Soc. in 1827, printed in vol. iv, pl. xiv, fig. 15, of the Trans. of the Geol. Soc., 1836.

— — *Morris.* Catalogue, 1843.

— — *Forbes.* Catalogue of L. G. Sand Fossils, Quart. Journ. of the Geol. Soc., vol. i, p. 346, 1845.

— — *Fitton.* Strat. Section, Quart. Journ. of the Geol. Soc., No. 11, p. 289, 1847.

— RAULINIANA, *D'Orb.* Pal. Franç. Ter. Crétacées, vol. iv, p. 80, pl. 490, 1847.

— TRUNCATA, *Bronn.* Index Pal., p. 656, 1848.

— — *D'Orb.* Prodrome, vol. ii, p. 84, 1850.

¹ I would recommend to the study of all scientific observers the instructive and valuable work by Professor Milne-Edwards, bearing for title 'Introduction à la Zoologie Générale, ou Considérations sur les Tendances de la Nature dans la Constitution du Règne Animal.' Paris, 1851.

Diagnosis. Shell oblong, irregularly oval, slightly convex, but compressed and flattened longitudinally along the middle; valves almost equal; beaks not very acute; truncated or rounded in front, shell thin, shining, horny; surface wrinkled by numerous concentric elevated lines of growth; more numerous at the sides. Length 13, breadth 8, depth $3\frac{1}{2}$ lines.

Obs. *Lingula truncata* was discovered by Dr. Fitton in the Lower Green Sand of Atherfield (Isle of Wight), Sandgate, and Peasemarch; it is the largest cretaceous *Lingula* with which I am acquainted, some specimens measuring full 13 lines in length. *L. truncata* is quite distinct from *Lingula ovalis*, Sow., M. C., tab. xix, fig. 4, as correctly stated by Professor Forbes in the 'Quarterly Journal,' vol. i, p. 346. I am now quite certain that Sowerby's specimens of *Lingula ovalis* were obtained from the Kimmeridge Clay, found in blocks at Pakefield in Suffolk, associated with other well characterised Oolitic species. *T. ovalis* was therefore never to my knowledge found in the Lower Green Sand of Sandgate, as stated by M. D'Orbigny, nor in the cretaceous period, where it is placed by several authors. M. D'Orbigny's *Lingula Rauliniana* is only a synonym of *L. truncata*, his description and figure quite agreeing with the specimens of that type, as any one may become convinced of on examination of the original specimens now deposited in the Museum of the Geological Society.

Plate I, figs. 27-28. A specimen, natural size, from the Lower Green Sand of Red Cliff, Isle of Wight, in my collection.

„ fig. 31. From a specimen found in the Lower Green Sand, of Sandgate; Dr. Fitton's figures were, unfortunately, not very well illustrated, which is perhaps the reason why some authors have not recognised the type.

2. LINGULA SUBOVALIS, Dav. 1852. Plate I, figs. 29-30.

Diagnosis. Shell regularly oblong, oval, the beak and front presenting nearly the same shape; valves almost equal, slightly convex, compressed; shell thin; surface smooth, marked only by a few concentric lines of growth. Length 7, width 4, depth $\frac{1}{2}$ lines.

Obs. This small *Lingula* is found in the Upper Green Sand, near Warminster, where it does not seem much to exceed the dimensions above given; it appears distinct from *L. truncata* by its more regularly oval shape, and much smaller size, nor would it seem to be the *Lingula ovalis* of Sowerby, which is a Kimmeridge Clay Shell, but placed erroneously by most authors in the Lower Green Sand, which is the reason why I supposed it so, while writing on this genus in Part III; but this opinion I afterwards relinquished, having been able to compare specimens from the two formations. We are therefore at present acquainted with only two *British* Cretaceous *Lingulas*, viz., *L. truncata* and *L. subovalis*; and in the Oolitic series other two, viz., *Lingula Beanii* and *L. ovalis*. I have named our shell, *Subovalis*, to indicate its approximation in shape to *L. ovalis*, Sow.

Plate I, fig. 29. A specimen from the Upper Green Sand, near Warminster, in the Collection of the British Museum.

„ fig. 29^a. A specimen, showing the interior and muscular impressions enlarged, likewise from the same locality, in the Collection of the British Museum.

„ fig. 30. Another specimen, from the Collection of Mr. Cunningham.

Genus—CRANIA, *Retzius*. 1781.

Shell inequivalved, circular, or subquadrate, more or less irregular, entirely or partially attached by the substance of its smaller valve to rocks, or other submarine bodies. Upper valve conical, with lateral or subcentral vertex, without hinge or ligament: four circular muscular impressions in each valve. Surface smooth, or longitudinally striated; arms fleshy, with spiral extremities; no calcareous supports. Structure strongly punctuated.

Some authors state to have found four or five species of British Cretaceous Crania, but all our researches have only brought to light two, viz., *C. Parisiensis*, and *C. Egnabergensis*. Of those mentioned, some are only synonyms; others, such as *C. spinulosa*, Nilsson, and *C. costata*, Sow., seem founded on erroneous determinations.

3. CRANIA PARISIENSIS, *DeFrance*. Plate I, figs. 1—7.

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| CRANIA PARISIENSIS, | <i>DeFrance</i> . | Dic. des Sc. Nat. vol. ii, p. 313, No. 3, 1819. |
| — | — | <i>Lamarck</i> . An. Sans. Vert., vol. vi, p. 239, 1819. |
| — | — | <i>Brongniart</i> . Desc. Geol. des Env. de Paris, pl. iii, fig. 2, 1822. |
| — | — | <i>Sow.</i> Min. Con., vol. v, p. 3, tab. 408, 1825. |
| — | — | <i>Hæninghaus</i> . Mon. des Crania, p. 9, fig. 8, 1828. |
| — | — | <i>Desh.</i> 1830. Ency. Meth., ii, p. 18, No. 8. |
| — | — | <i>Desh.</i> Nouv. Ed. de Lam., vol. vii, p. 300, No. 3, 1836. |
| — | — | <i>Dujardin</i> . 1837. Mém. de la Soc. Geol. de France, vol. ii, p. 222. |
| — | — | <i>Goldfuss</i> . Petref. Germ., p. 293, pl. 162, fig. 8, 1840. |
| — | — | <i>D'Orb.</i> Pal. Franç. Ter. Crétacées, vol. iv, p. 139, pl. 524, figs. 8—13, 1837. |
| — | — | <i>Ræmer</i> . Die vers Norddeutschen Kreidgeberges, 1840, p. 36, No. 3. |
| — | — | <i>V. Hagenow</i> . Jahrb., f. min., 1842. |
| — | — | <i>Morris</i> . Catalogue, 1843. |
| — | — | <i>Reuss</i> . Die Verstein. der Böhemischen Kreideformation, 1846, p. 53, No. 2. |
| — | — | <i>Tennant</i> . A Stratigraphical List of British Fossils, p. 47, 1847. |
| — | — | <i>Bronn</i> . Index Palæontologie, p. 342, 1848. |
| — | — | <i>D'Orb.</i> Prodrome, vol. i, p. 259, 1850. |
| — | — | <i>Dixon</i> . The Geology of the Tertiary and Cretaceous Formations of Sussex, p. 354, pl. xxvii, fig. 9, 1850. |

Diagnosis. Shell irregular, inequivalve, transversely oval, entirely attached by the substance of the lower valve to rocks, corals, echinodermata, &c., modelling itself to the object of attachment, the irregularities of which it fills up to a greater or less extent; margin much elevated, especially in front, rising obliquely or even vertically all round, except on the posterior side; the central portion is irregularly hollowed out; structure largely cellular, spongy or granular, particularly so round the margin; muscular impressions four in number, strongly produced in different examples; the two posterior ones variably circular, larger and more widely separated than the anterior ones; these last are usually in contact, being more elongated and depressed in the centre, between, and above which is seen a produced nose-shaped projection, somewhat variable in its details in different individuals; the digitated vascular impressions are likewise more or less marked. Upper or unattached valve thin, conical, patelliform, very convex, exteriorly covered by small granular asperities; vertex sub-central, with numerous concentric lines of growth. In the interior four deep muscular impressions; two irregularly circular or oval ones are situated near the posterior edge, widely separated, and corresponding to those seen in the same position on the attached valve; towards the centre, other two elongated muscular impressions are visibly in contact at their base, and forming long narrow uneven projections, detached, except at their origin, from the bottom of the shell, and directing themselves towards the lateral portion of the valve. Structure punctuated; dimensions variable. Length 7, width 11, height 4 lines.

Obs. This remarkable species has been fortunate, all authors having applied to it the same denomination,—an occurrence very rare among the Brachiopoda. It is frequently found in the Upper Chalk of many localities, but is a very irregular shell, few specimens bearing exactly the same shape; it is always attached by the whole surface of its lower valve, and, as stated above, modelling itself and filling up all the projections or depressions existing either on the rock or shell to which it is united, so that it cannot be detached from the place where it is fixed, provided this last is of a solid nature; but I have specimens that were joined during life to soft and perishable bodies, such as sponge, &c. One remarkable specimen, belonging to Mr. Catt of Brighton, presents an exact cast of the structure of a ventriculite to which it was fixed; it therefore remains very uneven and contorted where the object was rough and angular. In the Upper Chalk of Meudon this species is often met with, and I have picked up there specimens of *Ananchytes*, covered by more than fifteen or twenty individuals of all ages, illustrating in the clearest manner their formation. In the very young state the shell of the lower valve is so thin, except at its margin, that every accident of the object it sticks to is apparent and reproduced, the muscular impressions are faint and scarcely defined, the margin alone assuming a thickness ten or twelve times more considerable than that of the other portion of the valve; by degrees, however, as the shell acquires age, by successive layers of calcareous matter, it presents a greater and an unequal thickness, filling up and concealing the largest portion of the asperities existing on the object of attachment. Much difference may be noticed, likewise, in the

shape of the muscular impressions visible in the interior of both valves, so well described by that conscientious observer, M. Bouchard, who has devoted much time to the study of this genus.¹ He states, that "The *Cranias* present two kinds of impressions left by the adductor muscles,—those which are often deeply excavated in the thickness of the valves are produced by muscles that do not deposit calcareous matter, and which, by their insertion on the valve, prevent the mantle from depositing its calcareous substance on the part occupied by their base; we then see this pallial secretion surround the base of the muscles, and circumscribing these impressions with a calcareous crest or rim. The others, on the contrary, possessing the faculty of depositing calcareous matter, form projections that assume all kinds of shapes; therefore, in the interior of the upper valves of *Crania Parisiensis* and *C. abnormis*, we perceive the muscular deposits under the form of lanceolate and pedicular laminæ, rising with age from the bottom of the valve, to the height of several millimetres." The upper valve, from its extreme thinness, is seldom preserved, while the attached valve is very abundant. In England, it is sometimes found in the Chalk of Kent and Sussex, but it cannot be said to be common. In Plate I, I have endeavoured to illustrate a few of the principal variations assumed by this shell from a beautiful series of specimens, for which I am indebted to the kindness of several friends.

Plate I, fig. 1. A specimen, enlarged, of the attached valve, very adult, from Gravesend, in the collection of Mr. Bowerbank.

„ fig. 2^a. A very adult specimen, enlarged, from the same locality, in the collection of Mr. Bowerbank.²

„ fig. 2^b. A very adult specimen of the upper valve, likewise from the above-mentioned collection.

„ fig. 3. A fragment, much enlarged, of the lower valve.

„ fig. 4. Profile view of the upper valve.

„ fig. 5. Profile view of the lower valve.

„ fig. 6. The exterior of the upper valve, from the collection of Mr. Bowerbank.

„ fig. 6^a. Profile view of both valves, united, from the same collection.

„ fig. 7. A remarkably fine specimen, from the chalk of Meudon, in my collection, placed here to show how the shells sometimes clustered near each other in the young state; not finding room as they grew to develop themselves, they assumed the shape the space admitted, indenting and projecting one above another, one of the specimens preserving still its upper valve.

¹ 'Mémoire sur un Nouveau Genre de Brachiopode,' ('Annales des Sciences Nat.,' vol. xii, p. 84, 1849.)

² This valve has been rarely figured. Mr. Dixon gives a correct illustration in his work, and in a plate, entitled 'Collection de M. H. Michelin,' published some years back. Figs. 2 and 3 illustrate this valve, from Meudon, where it is extremely rare.

4. CRANIA EGNABERGENSIS, *Retzius*. Plate I, figs. 8—14.

- NUMULO ? *Stobæus*. Dissert. de Numulo Brattenbergensis, 1732, pl. i, figs. 3-4; and Opuscula in quibus Petrefactorum, 1753, tab. 1, figs. 3-4.
- CRANIA EGNABERGENSIS, *Retzius*.¹ Crania Oder., &c., in Berlin Gesellsch. Schaft, vol. ii, p. 75, tab. i, figs. 4, 7, 1781; Encyclop. Meth., pl. 171, figs. 6-7, 1789.
- CRANIA STRIATA, *Defrance*. Dict. des Sc. Nat., p. 315, No. 2, (non Nilsson, 1827,) 1818.
- — *Lamarck*. An. sans Vert., vol. vi, p. 239, No. 5, 1819.
- ANOMITES CRANIOLARIS EGNABERGENSIS, *Wahlenberg*. Petref. Telluris Svecanæ examinata in Nova Acta Societatis Scientiarum Upsaliensis, vol. viii, p. 60, 1821.
- CRANIA STRIATA, *Hæninghaus*. Beitrag zur Mondergattang Crania, No. 10, fig. A, 1828.
- — and C. OVALIS, *Woodward*. An Outline of the Geol. of Norfolk, pl. vi, figs. 15-16, 1833.
- STRIATA, *Deshayes*. Nouv. Ed. de Lamarck, vol. ii, p. 19, No. 9, 1836.
- — *Hisenger*. 1837? Lethea Succ., p. 84, pl. xxiv, fig. 10.
- CRANIA EGNABERGENSIS, *Bronn*. Lethea Geog., vol. i, p. 665, tab. xxx, fig. 2, 1837.
- — *Rœmer*. Die Vers. Norddeutschen Kreidgeberges, p. 36, No. 6, 1840.
- CRANIA STRIATA, *Goldfuss*. Petref. Germ., p. 295, pl. 162, fig. 10, 1840.
- OVALIS, STRIATA, SPINULOSA, *Morris*. Catalogue, 1843.
- EGNABERGENSIS, *D'Orb.* Pal. Franç. Ter. Crétacées, vol. iv, p. 142, pl. 526, figs. 1—6, 1847.
- STRIATA, SPINULOSA, *Tenant*. A Stratigraphical List of British Fossils, 1847.
- — *Dixon*. The Geol. of the Ter. and Cret. Formations of England, pl. xxvii, 1851.
- EGNABERGENSIS, *D'Orb.* Prodrome, vol. ii, p. 259, 1850.

Diagnosis. Shell irregular, inequivalve, circular, both valves presenting a more or less conical depressed shape; apex submarginal, nearest the posterior edge attached by a small or large portion of its lower valve to shells or corals, principally at or near the vertex of the lower valve. Surface ornamented by a variable number of costæ, radiating irregularly from the vertex in both valves, and after reaching the edge, pass it, forming a number of asperities all round, these likewise augmenting in number by the addition of smaller costæ appearing at a variable distance from the vertex, and irregularly intercalated between the larger ones; concentric lines of growth are also visible intersecting the striæ; the upper valve is most convex or conical; the interior of the lower valve is surrounded by a wide, rather flat, strongly granulated margin; four muscular impressions; the two pos-

¹ Retzius gives, in 1781, four good figures of his *Crania Egnabergensis*, and refers to the two illustrations published by Stobæus in 1732, under the name of *Numulo*; but the figures of this last author are not sufficiently detailed to be identified with certainty. I am fully convinced, however, that his fig. 4 is the same as that described afterwards by Retzius.

terior ones are more or less circular, lying close, and partially surrounded by the inner edge of the granulated margin; these are separated from each other by an almost equally wide and depressed space; the anterior pair are situated towards the centre, united together, and diverging in the form of a V, being more or less oval and depressed in the centre; between and above them is a small, produced, nose-shaped protuberance, the same wide margin is likewise visible in the upper valve, which is deeper, with four corresponding muscular impressions, disposed as in the attached valve, with this difference, that the anterior pair are larger, and a hollow is seen between and above them, where the projection in the lower valve exists. Structure punctuated; vascular impressions well defined. Dimensions variable; length 3, width 3, depth $1\frac{1}{2}$ lines.

Obs. This small *Crania* has received several names from different authors; it seems, however, to have been first noticed by Retzius under that name of *Egnabergensis* in 1781, which denomination has been adopted by many Palæontologists, although commonly known also by that of *C. striata*; *C. ovalis* of Woodward is only an accidentally elongated specimen of Retzius' species, and many specimens attributed to *C. costata* in England, are only simple varieties of the form under examination with fewer costæ,¹ or where the intermediate elevated striæ are few in number, or even often wanting, especially in young specimens; thus have been found undoubted *C. Egnabergensis* with only sixteen costæ, while others have thirty-eight on each valve. I do not, however, pretend to dispute the existence of a distinct form under the name of *costata*, having well-characterised specimens of it from the Cretaceous beds near Valogne; but none of the British shells which have come into my hands authorised me to admit the two species, nor do the figures given of *C. costata* in Mr. Dixon's work entitle me to decide the question. The manner in which this species was attached is also very remarkable; in general, as in fig. 8, it seems to have been simply fixed by a very small portion of the summit of its apex to slender corals or bryozoa, or other branched bodies; sometimes, as in fig. 9, its attachment extended along the delicate coral from the vertex to the margin on one side only, interrupting and indenting the costæ; in other and rarer cases, when attached to rocks, flat objects, or shells, its fixed surface was much larger, and after minute examination of what takes place in many other species, as we have described under the head of *Th. Wetherellii*. I do not see reason for separating those specimens, figs. 13 and 14, attached by the greater portion of their surface on *Spatangus*, a part of the costated portion rising all round. The internal, muscular, and other impressions do not present differences of any value, from

¹ Sowerby is the first describer of *C. costata*, which he illustrates in No. 12, fig. 6 of his 'Genera of Shells,' stating that he found it at Orglandes, (near Valogne, in France,) but does not mention having discovered it in England. He characterises thus his species: "*Cr. valvula superiore costis prominentibus radiantibus octo ad quindecim.*" In the same number and plate, fig. 3, he figures a small *Crania*, fixed by the greater portion of the attached valve to an echinus, stated to be from the Chalk of Norfolk, and which he supposes to be *C. Parisiensis*. This is, however, a mistake: it belongs to *C. Egnabergensis*, and is similar to the one I have figured, Pl. I, fig. 13.

what is seen in *C. Egnabergensis*. I have obtained from the chalk at Gravesend specimens of this species from the dimensions of a quarter of a line in diameter, to that of three lines; in these various specimens, the apex was likewise more or less sub-marginal, in some almost central.

C. Egnabergensis has been found in the upper and lower chalk of various localities, such as at Northfleet, Kent, by Messrs. Bowerbank, Morris, Woodward, myself, and many others; in that of Dover and Folkstone by Mr. Mackie, in the Sussex Chalk by Messrs. Catt and Dixon, in that of Norwich by Messrs. Woodward, C. B. Rose, Fitch, &c.; on the continent this species is found at Meudon, Fécamps, Vendôme (Loir et Cher), in France, but never at Hampton Cliff in England, as stated by M. D'Orbigny, whose figures of this species do not seem to have been drawn from very good specimens, the muscular impressions not being well characterised.

Plate I, figs. 8, 8^c. From the collection of Mr. Bowerbank.

- „ fig. 8^c. Enlarged.
- „ fig. 8^a. Interior of attached valve, enlarged.
- „ fig. 8^b. „ upper valve „
- „ fig. 8^d. Enlarged figure, shewing both valves united and attached to a coral.
- „ fig. 9. From the collection of Mr. Mackie.
- „ fig. 9^a. Enlarged.
- „ figs. 10, 11. Two young specimens from Gravesend.
- „ fig. 12. Elongated malformation, *C. ovalis*, Woodward.
- „ fig. 13. A specimen attached by a great portion of its lower valve to a *Spatangus* from Gravesend.
- „ fig. 13^a. Enlarged figure.
- „ fig. 14. Illustrating the profile of the same with both valves united, enlarged.

Genus—THECIDEA, *DeFrance*. 1828.

Animal with the mantle-lobes disunited, and adhering closely to the valves. Shell free, or attached by the larger valve, oblong, or transversely oval, more or less irregular, thickened, especially round the margin, structure perforated. Dental, or largest valve, partially or entirely attached by its own substance; or when young, in some species, by a pedicle issuing from the extremity of the beak; upper or unattached valve always less convex than the dental one; surface smooth, or otherwise ornamented; hinge line more or less straight, with two strong teeth in the attached valve, adapting themselves into corresponding sockets in the smaller valve; beak more or less produced, with a well-defined area and deltidium. Interior of valves variable: in larger valve a longitudinal, central, and two lateral ridges are generally more or less visible, under which two deep muscular impressions are seen: upper valve furrowed more or less deeply and regularly, to receive

the apophysary testaceous ridge, and leaving a small cavity in the upper portion of the valve for the body of the animal, these sinuous grooves varying in number, position, and extent, in different species; two strong lateral adductor muscles situated under the hinge.¹

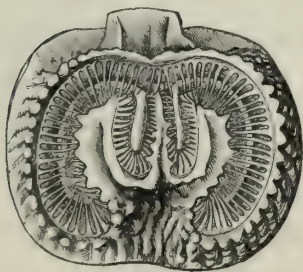
Obs. We are acquainted with only one British Cretaceous *Thecidea*; and although many species are found in the various beds of this system on the continent, they have not as yet been discovered in England.

5. *THECIDEA WETHERELLII*, *Morris*. Plate I, figs. 15—26.

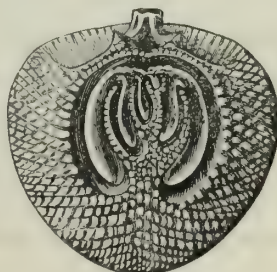
THECIDEA WETHERELLII, *Morris*, 1851. *Annals and Magazine of Natural History*, pl. iv, figs. 1—3.

Diagnosis. Shell inequivalve, irregular, more or less circular or pentagonal, as wide as long, or longer than wide; triangular towards the beaks, rounded laterally, and slightly indented in front; larger valve convex, attached in various ways, either by nearly the whole surface of its valve, the edges only being slightly elevated, or by a small portion near the beak, which is more or less produced; area narrow, deltidium large, triangular, and elongated. A longitudinal depression is visible, extending along the centre of the larger valve to the front, which is repeated to a lesser extent on the smaller valve; this last is slightly convex, smooth, with many concentric lines of growth; hinge line straight, articulating by means of two teeth in larger, and corresponding sockets in smaller valve. In the interior of larger valve, beneath the deltidium, the short lamellar processes are seen to occupy about a fifth of the length of the valve; the central one being the longest and most elevated, the other two appearing at the base of the dental plates, converge gradually to near the central septum; the inner surface of this valve is covered with close granular longitudinal striæ, the interior of smaller or upper valve is divided on each side in a deep

¹ In connection with the *Argiope* described in Part I, p. 9, Mr. Woodward and myself have re-



Th. Mediterranea.



Th. radiata.

examined a suit of specimens of the recent *Thecidea Mediterranea*, one of which (in my cabinet) retains the animal in excellent preservation. *Thecidea* has a calcareous loop, folded into two or more lobes, and lying in hollows of corresponding form, and excavated in the substance of the smaller valve; this loop or apophysary ridge supports the brachial membrane, whose thickened and ciliated margin is

apparently attached to the inner sides of the sinuous grooves. The *cilia* are very long, especially the outer series, which are directed inwards in the dried specimens. The loop exists in its most complete form in *Th. radiata* (Def.); each lobe of the loop adheres to part of the wall of the shell along its course, becoming free towards the visceral cavity.

arched or reniform sinus; the cardinal process is large, and the margin of the valve is minutely granulated.

Obs. This is the only British species of cretaceous *Thecidea* with which we are acquainted, and is known to us since 1847, at which period we had obtained specimens from Mr. Purdue, who found them while washing some chalk from Northfleet. It has likewise been discovered by Mr. Wetherell, and lately described and figured by Mr. Morris.¹ This species bears much external resemblance to *Th. Mediterranea*, and more especially to *Th. triangularis*, figured by me from the inferior Oolite and Lias in Part III, but quite distinct from both by the internal arrangements of the Apophysary system, which partakes most of the simplicity seen in *Th. hippocrepis*, but the dissepiment is not so wide in that species. It may likewise bear some resemblance to *Th. Broderipii*, of Michelotti;² but the figures of that shell are not complete enough to enable one to compare the internal disposition of the Apophysary system.

At the time Mr. Morris described this species, it was only known from the Upper Chalk of Gravesend or Northfleet, Kent, where it abounds; attached principally to *Echinodermata*, *Inoceramus*, and other shells; the smaller valve being almost always wanting, but the larger one, from being attached by the greater portion of its surface, is found adhering to the object on which it lived; at times it is assembled in great numbers, nor is it rare to find *Ananchytes* with from twenty to thirty specimens fixed to them. During my examination of the rich and interesting cretaceous collections assembled with great care by Messrs. Cunnington and Faulkner, of Devizes, I at once recognised the species under consideration obtained by these gentlemen in the Chalk of Pewsey (Wilts.), where it is most beautifully preserved, with both valves united in the free state, owing no doubt to their having been only slightly attached during life to perishable bodies, such as sponges, &c.; it is also clearly seen, that they were not always fixed by the whole or greatest part of their larger valve, as in the Gravesend specimens, but only partially so, as is illustrated by our figures 20, 21, 22, 23, 24, 25, 26. I may also remark, that, as in *Crania*, in some cases the ornaments or markings on the object of attachment are reproduced on the valves of the *Thecidea*. It is also singular, that we should find in England no other species, so many being met with in the foreign cretaceous beds.

Plate I, fig. 15. Natural size. From the Upper Chalk of Gravesend.

„ fig. 16. Interior of unattached valve magnified.

¹ Mr. Morris's figures of this species are not very fortunate. From the artist not understanding the character of the genus, he overlooked some of the most important points of structure; thus, in the figure of the larger or attached valve, the area and deltideum are not sufficiently characterised; the teeth are wanting, and the three small lamellar processes, as well as the granulation, incorrectly illustrated. In the figure of the interior of the smaller valve, there exists in the specimens a small bridge-shaped process near the hinge, marked *b* in my fig. 16, but omitted in those given by Mr. Morris. We have endeavoured, in our numerous illustrations of this species, to make up for these deficiencies.

² Michelotti, 'Desc. des Foss. des Ter. Miocene d'Italie,' Sept. 1847, pl. i, fig. 26.

Plate I, fig. 17. Interior of attached valve magnified.

„ figs. 18, 19. Exterior and profile of the species magnified, from Gravesend.

„ figs. 20—26. Different specimens from the Chalk of Pewsey, Wilts., showing various modes of attachment, from the Collection of Messrs. Cunningham and Faulkner, of Devizes.

Genus—*ARGIOPE*, *Deslongchamps*. 1842. (*Mégathyrus*, *D'Orb.*, 1847.)

Shell inequivalve, variable in shape, semi-orbicular, quadrate, or transversely oval. Valves unequally convex, smooth, or variously costated: the dental valve deepest, beak produced, with a large depressed triangular area, foramen large, completed by the umbo of smaller valve. Structure strongly punctuated; margin thickened and granulated. Hinge articulating by the means of two teeth in the larger and corresponding sockets in the smaller valve: apophysary system consisting of a distinct loop, originating at the base of the dental sockets, and furnished with converging processes: one or more radiating elevated ribs or dissepiments arising from the inner surface of the smaller valve, the central septum being more produced and larger than the lateral ones, which are often indistinct.

Obs. We are only acquainted with one British cretaceous *Argiope*. (See observations on this genus in Part I.)

6. *ARGIOPE DECEMCOSTATA*, *Ræmer*. Sp. Plate III, figs. 1—13.

TEREBRATULA DECEMCOSTATA, *Ræmer*. Dic. Vers. Norddeutschen Kreidgeberges, 1840, p. 41, tab. vii, fig. 13.

— *BRONNII*, *V. Hagenow*. Mon. der. Rügensch. Kreide Versteinerungen in Neuv. Jahrb., fig. min. 1842, tab. ix, fig. 7.

— *BUCHII*, *V. Hagenow*. Ib., tab. ix, fig. 8.

— *DUVALII*, *Dav.* 1847. Lond. Geol. Journal, p. 113, pl. xviii, figs. 15—18.

MÉGATHIRIS CUNEIFORMIS, *D'Orb.* 1847. Pal. Franç. Ter. Crétacées, vol. iv, p. 147, pl. 521, figs. 1—11.

TEREBRATULA DECEMCOSTATA, *Bronn*. Index Palæont., p. 1234, 1848.

MÉGATHIRIS CUNEIFORMIS, *D'Orb.* Prodrome, vol. ii, p. 259, 1850.

Diagnosis. Shell of a somewhat pentagonal transverse form, larger or dental valve convex, beak produced, not recurved, area large and triangular, variable, in its dimensions as wide as the shell; foramen irregularly circular or triangular, occupying often about one third of the area, and laterally distinctly margined by two narrow deltideal plates,¹ the anterior portion being completed by the umbo of smaller or socket valve, which is often

¹ I do not agree with M. D'Orbigny while stating that this genus is deprived of deltideum; to me it is quite apparent, although not very great.

worn away at the umbo by friction, presenting thus an accidental false area in the smaller valve; this valve is less convex and more compressed than the dental one. Surface ornamented by a variable number of large rounded costæ, between which a slightly concave space is seen; the two principal ones, or those nearer the centre, are the largest, and more or less separated by a mesial furrow existing in both valves; the costæ and furrows correspond to each other, and do not indent, as in the plaited *Spirifers* and *Rhynchonellas*, &c. Valves articulating by means of two teeth in the dental or larger valve, and two sockets in the smaller one; from under the crura in socket valve, a central triangular septum gradually arises, and attains its greatest elevation at about four fifths of the length of the shell, after which it descends by an almost perpendicular line to the bottom of the valve; margin wide all round, and strongly punctuated; in the interior of dental valve, besides the two strong teeth, a small slightly elevated longitudinal septum is seen to extend to about half the length of the shell. Structure punctuated; dimensions very variable. Sometimes length 2, width 1, and not quite 1 line deep; at other times, length 1, width 1, depth $\frac{1}{2}$ line.

Obs. This little shell seems to have been first noticed in the Cretaceous Formations by Roemer, under the denomination of *Terebratula decemcostata*; but the figures of that author not reminding one of the usual form, is probably the reason why the shell has received so many other names, owing likewise to its variable appearance, a character frequently lost sight of by most authors, who, out of varieties, have made many species; thus, *Ter. Bronnii* and *Buchii* of V. Hagenow seem to me, in all likelihood, only varieties with few or more costæ; we frequently find undoubted specimens of this species having either six, eight, or ten; it is therefore evident, that it is highly improper to give names from such a variable character. Some specimens do not present their greatest width at the hinge line, being rounded in that portion, while others, on the contrary, assume at the hinge the form of elongated wings, giving it a close resemblance to some *Spirifers*, &c. From my ignorance of Roemer's and V. Hagenow's figures, I described this species in 1848 under the name of *Ter. Duvalii*, which must be considered a synonym; a little later, M. D'Orbigny fell into the same error, by proposing that of *Cuneiformis*; it is singular that author should have committed this mistake, since, in p. 147 of his 'Pal. Franç.,' vol. iv, while characterising his genus *Mégathiris*,¹ and after having enumerated several recent types, he states: "En espèces Fossiles le *T. decemcostata* of Roemer;" and although, admitting this species in his 'Pal. Franç.,' he omits it completely in his 'Prodrome,' vol. ii, 1850; but allowing even that M. D'Orbigny considered *T. decemcostata* as specifically different from the chalk species here described, his name would have to give place to one of those published by V. Hagenow in 1842, but with which work M. D'Orbigny was probably unacquainted.

A. decemcostata bears the greatest outward resemblance to some recent forms of this

¹ The term *Mégathiris* is a synonym of M. Deslongchamps' genus *Argiope*, established long before.

genus found in the Mediterranean; but in the interior of these last, the three well-defined, elevated septa, figs. 14 and 16^{a b} of our Plate, are prominent, which is not the case in the interiors of the chalk species I have seen, and which, I must confess, I have never observed in the Meudon specimens, as represented in figs. 9 and 10 of M. D'Orbigny's Plate 521, the central one only being perceptible.

This remarkable variation presented by the fossil species above described, is likewise equally prevalent in the small recent type originally described under the appellation of *Anomia decollata*, by Chemnitz,¹ as I became convinced from a numerous suit of this species given to me by Professor Forbes, and dredged by himself in the Mediterranean, these variations having tempted Risso² to propose the following names:—*Ter. urna-antiqua*, *T. cardita*, *T. emarginata*, *T. cuneata*; some of which being likewise adopted later by Sig. Philippi³ and others, proving how difficult it is often to pronounce with certainty the limits to be assigned to a species.

In many adult specimens of *A. decemcostata*, as already noticed, the umbo is much worn, no doubt from the shortness of the muscular pedicle of attachment forcing the shell to lie so close to the object to which it is fixed as to wear it by continual friction, caused by the opening and shutting of the valve; this is likewise the case with many specimens of the recent *A. decollata*, as is seen from the fig. 16 of our Plate; but in young specimens, and even in more aged shells, the pedicle fibres must have been longer, as both beak, area, and umbo are quite perfect, showing no traces of the friction above alluded to.

Argiope decemcostata is found in the Upper Chalk of Gravesend or Northfleet, and occurs more abundantly in the Chalk filling Echinodermata, in the washing of which Mr. Purdue procured many specimens. Mr. Harris has likewise met with it in the Chalk detritus of Charing (Kent); Mr. Cunningham discovered it at Pewsey, in Wiltshire, and is often found in company with *Th. Wetherellii*. On the Continent it is not very rare at Meudon and other places, although always troublesome to obtain, from its extreme minuteness. M. V. Hagenow found it also along with other interesting forms in the Chalk of the Prussian or Belgian dominions.

Plate III, figs. 1, 2, 3, 4, 5. A specimen from the Chalk detritus of Charing, Kent, in the Collection of Mr. Harris.

- „ fig. 6. Interior of smaller valve magnified.
- „ fig. 6^a. Section of smaller valve magnified, ^a central septum.
- „ fig. 7. Interior of larger or dental valve enlarged.
- „ figs. 8, 9. A short square variation, with few costæ, from Gravesend.
- „ fig. 10. Idem.
- „ figs. 11, 12. A very transverse spirifer-shaped variation.

¹ 'Systematische Konchylien Habitat,' vol. viii, pl. lxxviii, fig. 705, 1785.

² 'Hist. Nat. des Principales Prod. de l'Europe Méridionale,' vol. iv, Nos. 175, 177, 179, 180, 1826.

³ 'Enumeratio Moluscorum Siciliæ,' 1836.

- Plate III, fig. 13. An enlarged illustration of the beak and worn umbo; A. Septum in smaller valve seen through the foramen.
- „ figs. 14, 15. *Argiope decollata*—recent species placed here to illustrate the three elevated dissepiments ^a and ^b. The loop is not introduced, (see woodcut, Part I.)
- „ fig. 16. A profile view of the recent form, showing how close it lies to the object to which it is attached.

Genus—MAGAS, *Sowerby*. 1818.

Animal unknown; fixed to marine bodies by a pedicle issuing out of the foramen of the larger valve. Shell small, inequivalve, generally more or less regularly oval; structure punctuated; beak truncated by a foramen, extending to the umbo of smaller valve; hinge articulating by means of two teeth in the larger and corresponding sockets in smaller valve; apophysary system in the imperforated valve composed of an elevated longitudinal septum, reaching from one valve to the other, to which are affixed two pairs of calcareous lamellæ, differently disposed; the lower pair are riband-shaped, attached first to the crural base: they direct themselves by a gentle curve to near the anterior portion of the septum, to the sides of which they are affixed; the second pair arise on either side of the upper edge of the septum, extending in the form of two triangular anchor-shaped lamellæ.

Obs. I have fully described this genus under the species *Magas pumilus*, and therefore must refer to it for further details.

7. MAGAS PUMILUS, Sow. Plate II, figs. 1—12 and 33.

Figured by Faujas in 1789, 'Histoire de la Montagne de St. Pierre de Maestricht,' pl. xxvi, fig. 6 (but not named).

MAGAS PUMILUS, *Sow*. Min. Conch., vol. ii, 1818, p. 40, tab. 119, figs. 1—5.

TEREBRATULA CONCAVA? *Lamarck*. 1819. An. sans Vert., vol. vi, p. 251, No. 26.

See likewise *Dav.*, Annals and Mag. of Nat. Hist., 2d ser., vol. v, June, 1850.

MAGAS PUMILUS, *Parkinson*. 1822. An Introduction to the Study of Organic Remains, p. 227, pl. vii, fig. 14.

— — *Brongniart and Cuvier*. Descript. Géol. des Env. de Paris, 1822, pl. iv, fig. 9.

— — *DeFrance*. 1823. Dic. des Sci. Nat., vol. xxviii, p. 13, fig. 1.

— — *Blainville*. 1826. Malacologie, pl. liv, fig. 1, (non *Magas pumilus*, *Sow.*)

— TRUNCATA (*Rose*), *Woodward*. 1833. Outlines of the Geol. of Norfolk, tab. vi, fig. 9.

- TEREBRATULA PUMILA*, *Von Buch*. *Über Ter.*, 1834; and *Mém. de la Soc. Geol. de France*, vol. iii, 1st ser., p. 206, pl. xix, fig. 5, 1838.
- *CONCAVA*, *Deshayes*. 1836. *Nouv. Ed. de Lamarck*, vol. vii, No. 26.
- MAGAS PUMILUS*, *Bronn*. *Leth. Géog.*, p. 662, pl. xxx, fig. 1, 1837.
- — *Brown*. *Illustr. of Fossil. Conch.*, pl. xlix, figs. 5 and 13, 1838.
- — *Morris*. *Catalogue*, 1843.
- — *D'Orb.* 1845. *Geol. of Russia and Oural*, vol. ii, p. 495, pl. xliii, figs. 27—30.
- — *D'Orb.* 1847. *Pal. Franç. Ter. Crétacés*, vol. iv, p. 54, pl. 501.
- — *Bouchard and Dav.* *Bulletin de la Soc. Géol. de France*, vol. v, 2d ser., p. 139, pl. ii, figs. 1—11, 1848; and *Dav.*, *Bull. Soc. Géol. Fr.*, vol. vii, 2d ser., p. 62, pl. i, figs. 7—9, 1849.
- — *Bronn*. *Index Pal.*, p. 699, 1848.
- — *Tennant*. *Strat. List of Brit. Fos.*, p. 47, 1847.
- — *Dav.* *Annals and Mag. of Nat. Hist.*, vol. v, pl. xv, fig. 2, 1850.
- — *D'Orb.* *Prodrome*, vol. ii, p. 258, 1850.

Diagnosis. Shell equilateral, inequivalve, oval or circular; larger valve convex; beak more or less recurved, sometimes almost straight, slightly truncated by a triangular foramen extending from the beak to the umbo; deltideum small and lateral, not surrounding the foramen; false area small or large; imperforated valve slightly concave or moderately convex; surface smooth, marked by numerous concentric lines of growth; structure largely or more or less closely punctuated in the form of lozenge-shaped punctures. The apophysary system is complicated, composed, in the smaller valve, of a mesial, longitudinal, elevated triangular septum, extending to about two thirds of the length of the valve, arising from under the crura by a gentle curve, reaches and touches the larger valve near its centre, whence it descends by an almost perpendicular line to the bottom of the valve; to this septum are attached two pairs of calcareous lamellæ, differently shaped; they are fixed to the inner side of the strongly-developed socket walls, first under the form of short, slender, converging stems, soon becoming delicate ribband-shaped lamellæ, directing themselves by a gentle elevating curve to near the anterior portion of the septum, to the sides of which they are attached. The second or upper pair arise on either side of the upper edge of the septum, and extend along its edge to more than half its length, in the form of two triangular anchor-like lamellæ, wide at their base, the sides converging to a point; each lamella forms an inward curve, this process being, most probably, destined to lodge and protect the visceral parts of the animal, leaving on either side a considerable space for the cirrated arms, attached to the under pair of lamellæ above described.

The interior of the larger valve is simple; a central longitudinal, slightly elevated, obtuse projection is seen to extend to about two thirds of the length of the shell, on either side of which, well-defined, elongated muscular impressions are visible, laterally edged in adult individuals by a thickness of the shell, probably occasioned by a superabundance of calcareous matter deposited by a plait of the mantle at the basis of each adductor muscle,

the insertion of which at the bottom of the valve having prevented the calcareous deposition extending over the space occupied by the muscular fibres; on either side, at the base of the septum in smaller valve, are seen two muscular impressions, corresponding with those just described in the larger valve, but of much smaller dimensions; the valves articulate by means of two strong teeth in the larger, corresponding with sockets in smaller valve, their separation becoming impossible without fracture. Dimensions variable; length 4, depth 3 lines.

Obs. Sowerby wisely created this genus in 1818, by observing that its internal organisation differed materially from that of other Terebratuliform shells; he states: "In the middle of the shell rises a thin longitudinal septum, reaching from one valve to the other, the upper part of it is perpendicular; on each side are two shelf-like appendages, one over the other, the upper ones united by slender processes to the hinge. . . . The resemblance of the arched septum to the bridge of a violin has suggested the generic name; to which valve this septum is attached I have not been able to ascertain, because I could not open the shell without breaking it." In 1845, having received from my friend, the late Mr. Duval, a great number of perfect specimens of this species, derived from the Upper Chalk of Meudon, near Paris,—M. Bouchard and myself proceeded to develop and examine the internal structure, which we fully described and illustrated two years after in the 'Bull. de la Soc. Géol. de France,' vol. v, 2d ser., p. 139, pl. ii, principally on account of the imperfect figures given by M. D'Orbigny in his 'Pal. Française,' proving that that author had not been as fortunate as ourselves in finding out the exact disposition of the internal apophysary system; the upper anchor-like lamellæ having been omitted and unmentioned in the description which appeared long after the publication of our paper. From observation, we were enabled to clear the doubts expressed by Sowerby, showing that the septum was attached solely to the bottom of the smaller valve. Since 1818, this species has often been confounded and misunderstood by various authors, such as Baron von Buch, Lamarck, and others. It is, however, most beautifully and clearly distinguished from all other Brachiopoda by its internal organisation, approaching to the only two genera, *Bouchardia*¹ and *Waltonia*,² proposed by myself some time back, these forming, along with *Magas*, a small family, comprising but few species. From *Bouchardia* and *Waltonia*, *Magas* differs in the form of its beak, foramen, and teeth; in *Bouchardia* the foramen is completely surrounded by the substance of the shell, and separated from the umbo *without deltideum*; while in *Waltonia* the position of the foramen, deltideum, and umbo is similar to that of the genus *Terebratulina*; this last, however, approaching more to *Magas* by the simplicity of its hinge, which is remarkably complicated in the genus *Bouchardia*. Besides these particular family characters, we find the same central, elevated septum, but different in its details. In *Magas*, in addition to the two riband-

¹ 'Bull. de la Soc. Géol. de France,' vol. vii, 2d ser., p. 62, pl. i, figs. 1—6, 1849.

² Davidson, "On the Genus *Waltonia*," 'Annals and Mag. of Nat. Hist.,' vol. v, 2d ser., 1850, pl. xv, fig. 1.

shaped lamellæ described, we observe two upper anchor-like lamellæ, situated parallel to the under ones; while in *Bouchardia* the under ones are completely wanting. In *Waltonia*, on the contrary, we have hitherto observed only the lower ones.¹

Since the period of Mr. Bouchard's and my own publications on the genus and species under notice, I have assembled a very extensive suit of British specimens, which enabled me to collect some additional facts regarding the external shape and variations sometimes assumed by this interesting little shell, which does not seem to have ever exceeded much more than 5 or 6 lines in length. The shape of the beak, as well as the form of the smaller valve, often producing great variations in its external aspect; in general, the smaller valve presents a slight longitudinal depression appearing at some distance from the umbo, and extending to the front, the beak being more or less incurved; but from several remarkable specimens discovered by Messrs. C. B. Rose, Fitch, Catt, Woodward, and myself, it appears that in some cases the smaller valve becomes more or less convex without depression, the beak being almost straight, and exhibiting a greater or less developed area and foramen, as may be seen from the series of illustrative figures in Plate II, which I have selected out of a vast number of specimens, to show the passages of form;² in figs. 1 and 2 the beak is much recurved, and the smaller valve more or less concave; in fig. 4 it is less so, the foramen being more visible; in 5 and 6 the smaller valve is slightly convex, the beak hardly recurved, and in the two extremes of 7 and 8, this last is almost straight, showing a large area and foramen. On closely examining the latter exceptional variations or malformations, I soon became convinced that they arose from local causes, and especially from the shortness of the pedicle muscular fibres, forcing the beak and area to lie so close to the object of attachment, as to prevent the curvature of the beak; this is likewise proved by the umbo of the smaller valve in these specimens being worn by friction, as we remark in many specimens of *Argiope*, &c.; in very young individuals the beak is also almost straight, becoming recurved at a more advanced period of growth. *Magas pumilis* is circular, oval, or more or less elongated, as may be perceived from figs. 9, 10, 11. Sowerby's illustration and type of *Magas* does not show a very recurved beak, which at the time we first described the genus we believed to be a mistake, owing to the Meudon specimens not

¹ While looking over the valuable collection of M. Deshayes in Paris, I was agreeably surprised to find in one of his drawers the interior of a Cretaceous species, from the *Tourtia* of Belgium, described by Viscount d'Archiac in the second volume of the 'Mém. de la Soc. Géol. de France,' p. 333, pl. xxii, fig. 4, under the name of *Terebratula orthiformis*, and later, by M. de Koninck, under that of *Orthis millepunctata*; in this shell we find the same arrangements as in *Magas*, to which genus the species above noticed will have to be referred. Unfortunately, the upper pair of lamellæ are imperfect in M. Deshayes' specimen.

² Mr. Woodward, in his 'Synoptical Table of British Organic Remains,' 1830, p. 22, mentions three species of *Magas*, *M. pumilus*, Sow., *M. magna*, and *M. punctata*, all from the chalk of Norwich; but as these last two are MS. names, unaccompanied by figure or description, we cannot offer any positive opinion on the shells intended as types, but it is probable, if not certain, that they were made out of the extreme shapes of *Magas* above noticed and figured in our plate.

presenting this peculiarity; but I have since observed, as above stated, that specimens did really at times assume the aspect of Sowerby's figures, and varied even to a greater extent.

I cannot understand what can have induced M. D'Orbigny to place in the family of *Magasidae* the genus *Terebratulina*, which is completely and widely separated from *Magas* by its internal arrangements, as may be seen by casting a glance to the interior of *Caput Serpentis*, or to that of any other species of the genus. If *Terebratulina* is admitted to belong to the same family as *Magas*, I see no reason why all the others with calcareous appendages should be separated, several having much more important family affinities; the only reason stated by M. D'Orbigny being based on the erroneous supposition, that *Terebratulina* was unprovided with a deltideum. I have elsewhere shown that it really exists to a greater or less extent in all the species of that genus, and particularly on *T. substriata* Schlotheim, an Oolitic form, possessing the true internal character of *Terebratulina*, but rejected and placed by M. D'Orbigny in that of *Terebratula*, from the well-developed deltideal plates, proving how dangerous it is to class certain shells from mere external appearances, without giving full weight to the far more important internal arrangements connected with the disposition and the organisation of the animal.

Magas pumilus, to my knowledge, has not been observed lower down than the Upper, and perhaps Lower Chalk; it was found at Maudesly by Mr. Sowerby, at Trimmingham by Mr. Bowerbank, at Norwich by Mr. Fitch and the Rev. Mr. Image, at Brighton by Mr. Catt, and at Letheringsett, West Norfolk, by Mr. C. B. Rose, &c. On the Continent it is abundant; at Meudon near Paris, at Sens, Fécamp, near Valogne, and St. Gervais near Epernay in France, at Vaclo in Belgium, Simbrisk in Russia, &c.

Plate II, fig. 1. From the Norwich Chalk, in my Collection, enlarged.

„ fig. 2. A specimen, in which the smaller valve is slightly concave.

„ fig. 3. From the Chalk of Norfolk, in the British Museum, showing a very thickened margin and adult shell.

„ fig. 4. From the Chalk of Trimmingham, in the Collection of Mr. Bowerbank.

„ fig. 5. From my Collection.¹

„ fig. 6. In the Collection of British Museum.

¹ Some of my friends urged me to make two species out of all these forms of *Magas*, from the extraordinary difference presented between such specimens as fig. 1 and figs. 7, 8; but I should be puzzled where to draw a line of demarcation, when it is remembered that figs. 7, 8, and 33, as well as 10 and 11, are quite exceptional forms, arising, no doubt, from malformations and accidental causes; besides which, Mr. Sowerby's type of *Magas pumilus* was created on specimens such as figs. 2, 4, and 5, which are intermediate in shape between those extremes in which the beak is much incurved, and those that are not so disposed. I consider figs. 1, 2, 3, 4, and 5 the usual forms of *Magas pumilus*, the remaining figures being accidental malformations. The illustration of *Magas pumilus*, given by M. D'Orbigny, in the work on Russia and the Oural, pl. xliii, fig. 27, closely resembles the real type of this species as figured by Sowerby, and is similar to our fig. 4; in it, as may be observed, the smaller valve is slightly convex and not depressed; the beak is likewise not much recurved, showing the area and foramen in all its extent.

Plate II, figs. 7, 8. Two remarkable malformations, in the Collection of Mr. C. B. Rose, from Letheringsett, West Norfolk.

„ figs. 9, 10, 11. Elongated varieties, in the Collection of the Rev. T. Image.

„ fig. 12^b. Interior of smaller valve.

„ *a*. The socket walls.

„ *i*. The sockets where the teeth, *j*, in the larger valve articulate.

„ *f*. Extremity of the septum.

„ *c*. Lower pair of ribband-shaped lamella.

„ *e—e'*. Upper or anchor-shaped pair.

„ fig. 12^c. Illustrates a profile view or section of the interior of both valves, the septum is seen to touch the larger valve at the point *k*.

„ fig. 12^a. Interior of larger valve illustrated.

„ fig. 33. From a remarkable malformation from the Sussex Chalk, in the Collection of Mr. Catt; this unique specimen varying so much from the common type, exhibits three marked stoppages of growth.

Genus—TEREBRATELLA, *D'Orb.* 1847.

Animal attached to submarine bodies by the means of a pedicle issuing from the beak of larger valve. Shell inequivalve, elongated, or transverse, variable in shape; valves convex; structure punctuated, smooth, or variously striated and plaited; beak truncated by a foramen of an oval or irregularly triangular shape, placed more under than above the summit; deltideum in two pieces, disunited in many cases, the aperture being completed by a small portion of the umbo; cardinal area more or less defined; loop (to which are affixed the arms) doubly attached, proceeding from the crura, but before attaining its greatest length, it gives off a flat, wide, more or less horizontal process, likewise attached to a central longitudinal, more or less elevated septum, the principal lamella proceeding till it doubles itself in the shape of a loop, as in true *Terebratulæ*.

Obs. I am only acquainted with two certain species of British Cretaceous *Terebratella*; it is possible that there may exist one or two more, but which, until future discoveries, I have left under the genus *Terebratula*.

8. TEREBRATELLA MENARDI, *Lamarck*, Sp. Plate III, figs. 34—42.

TEREBRATULA MENARDI, *Lamarck*. 1819. *An. sans Vert.*, vol. vi, p. 256, No. 50.

— — *Parkinson*. *An Introduction to the Study of Org. Remains*, p. 227, 1822.

— — *DeFrance*. 1828. *Dic. des Sc. Nat.*, vol. liii, p. 160.

- TEREBRATULA MENARDI, *V. Buch.* 1834. *Über Ter.*, and *Mém. de la Soc. Géol. de France*, vol. iii, p. 184, pl. xvii, fig. 6, 1838.
- — *Deshayes.* *Nouv. Ed. de Lamarck*, vol. ii, p. 344, No. 50, 1836.
- TRUNCATA, *Sow.* *Min. Con.*, vol. vi, p. 71, tab. 537, fig. 3, 1829.
- — *Morris.* *Catalogue*, p. 137, 1843.
- — *Forbes.* *Quart. Journ. of the Geol. Soc.*, p. 346, No. 105, 1845.
- — *Tennant.* *A Strat. List of British Fossils*, p. 47, 1847.
- TEREBRATULA MENARDI, *D'Orb.* *Pal. Franç. Ter. Cretacées*, vol. iv, p. 118, pl. 517, figs. 1—15 (not *T. Astieriana*, *D'Orb.*), 1847.
- TEREBRATULA — *Bronn.* *Index Pal.*, p. 1241, 1848.
- TRUNCATA, *Austen.* *Quart. Journ. of the Geol. Soc.*, vol. vi, p. 477, 1850.
- MENARDI, *Cunnington.* *Quart. Journ. of the Geol. Soc.*, vol. vi, p. 454, 1850.
- TEREBRATULA — *D'Orb.* *Prodrome*, vol. ii, p. 172, 1850.
- TEREBRATULA — *Guéranger.* *Bull. de la Soc. Géol. de France*, vol. vii, 2d ser., p. 803, 1850.

Diagnosis. Shell semicircular, generally transverse, as wide, or wider, than long; rarely longer than wide; hinge-line forming a very obtuse angle, sometimes nearly straight, and almost as wide as the shell; larger or dental valve most convex, with a longitudinal sinus, extending from the beak to the front; beak large, straight, presenting a well defined, oblique, triangular area, truncated by a large foramen, and completed by two indented deltideal plates, which separate it more or less from the umbo; smaller valve less convex than the dental one, with a well-defined mesial fold extending from the umbo to the front, and producing an elevated curve; surface of valves ornamented by a variable number of sharp plaits, rarely bifurcating, but more commonly augmenting by the intercalation of other costæ at different distances from the umbo and beak. From eighteen to thirty plaits may be counted on each valve, according to age; from six to seven ornamenting the mesial fold and sinus; these longitudinal plaits are more or less intersected by concentric wrinkled lines of growth, often so close as to give the costæ a somewhat granulated appearance. Structure punctuated; in the interior of smaller valve the boss is much produced, on either side of which two deep condyles are seen to receive the articulating teeth of the dental valve; the loop is doubly attached; a slightly elevated longitudinal ridge is visible in the interior of larger valve, extending to about half the length of the shell; dimensions variable: length $6\frac{1}{2}$, width 7, depth 4 lines.

Obs. Professor Forbes, Bronn, Morris, and others have long considered the *Ter. truncata*, Sow., as a synonym of *T. Menardi*, Lamarck, an opinion in which I quite coincide, from having compared with great care many specimens of our British shell with those from France, and collected by myself in both localities. M. D'Orbigny, however, believes that our views are erroneous, and I suppose without having been able to examine a series of

British specimens, has given it the name of *T. Astieriana*. It is necessary to remark that many of the shells found in the Green Sand of Farringdon, whence our British specimens were derived, are more or less rolled, and the valves disunited, the plaits being slightly blunted; but during a later visit to that locality, I was able to obtain a few examples quite as sharp and perfect as any of those from Mans, and corresponding exactly with the description of *T. Menardi*, by Lamarck and M. D'Orbigny, and which may be seen by comparing the two figures we have purposely given in Plate III of the French and British specimens: fig. 42 is a French *T. Menardi* from Mans; fig. 38 a British specimen from Farringdon; wherein these differ I am at a loss to perceive; the same number of plaits and mesial fold; the same character of area, foramen, and general aspect; they both possess the same wrinkled concentric lines of growth stated by M. D'Orbigny to occur in *T. Menardi*, but *not*, according to him, in *T. Astieriana*, in which the number of costæ are more numerous, of which I am convinced, from having two typical specimens now before me, given to me by M. D'Orbigny himself, differing by several characters from the Farringdon shell, being more oval, flatter, and possessed of a greater number of smaller plaits. Our British specimens are, it is true, generally smaller than the French ones, and rather thicker, but this no doubt arises from accidental and local causes, which favoured more the development of the Mans specimens, an occurrence so frequent among animals where local causes produce different races and varieties. *Ter. Menardi* is stated to occur in Lower Green Sand, near Devizes, by Mr. Cunnington;¹ on the Continent it is abundant in beds of Mans (Sarthe), &c.²

Plate III, figs. 34, 35, 36, 37, 38, 39. Specimens from the Green Sand of Farringdon³ in my collection.

- „ fig. 42. A French specimen from the Mans.
- „ fig. 41. The smaller valve, showing the calcareous loop enlarged.
- „ fig. 40. The dental valve enlarged.

9. *TEREBRATELLA PECTITA*, Sow. Sp. Plate III, figs. 29—33.

- TEREBRATULA PECTITA*, Sow. M. Con., vol. ii, p. 87, tab. 138, fig. 1, 1818. (Non *Pectita*, Nilsson Petrefacta Succana, pl. iv, fig. 9, 1827.)
- — Lamarck. An. sans Vert., vol. vi, p. 255, No. 46, 1819.
- — Parkinson. An Introduction to Org. Rem., p. 227, 1822.
- TEREBRATELLA PECTITA*, Brongniart et Cuvier. Descr. Geol. des Env. de Paris, pl. ix, fig. 3, 1822.

¹ 'Quart. Journ. of the Geol. Soc.,' vol. vi, p. 454, 1850.

² I believe Mr. Austen in error while stating, in the 'Quart. Journ. of the Geol. Soc.,' vol. vi, p. 477, that *T. truncata*, Sow., is likewise found in the Upper Oolitic beds of Germany, whence at least I have never seen any authentic specimen.

³ The age of the Farringdon beds has not yet been satisfactorily settled. Mr. Austen and others state them to be Lower Green Sand.

TEREBRATELLA PECTINATA, *Smith*. Identified by Organised Fossils, fig. 4, 1826 or 1827.

- PECTITA, *DeFrance*. Dic. des Sc. Nat., vol. liii, p. 159, 1828.
- — *V. Buch*. Uber Ter., 1834, and Mém. de la Soc. Géol. de France, vol. iii, p. 168, pl. xvi, fig. 12, 1838.
- — *Deshayes*. Nouv. Ed. de Lamarck, vol. vii, p. 343, 1836.
- — ? *Hisinger*. Leth. Succ., p. 79, pl. xxii, fig. 13, 1837.
- — *Rœmer*. Des Vers. Nordd. Kreid, 1840.
- — *Morris*. Catalogue, 1843.

TEREBRATELLA PECTITA, *D'Orb*. Palæont. Franç. Ter. Crétacée, vol. iv, p. 120, pl. 517, figs. 16—20.

TEREBRATULA PECTITA, *Bronn*. Index Palæont., p. 1244, 1848. (But not the fig. 3 of *Faujas*, as stated by Professor Bronn.)

- — *Dav*. Notes on an Examination of Lamarck's Brachiopoda. (Annals and Magazine of Natural History, vol. v, 1850.)

TEREBRATELLA PECTITA, *D'Orb*. Prodrôme, vol. ii, p. 173, 1850.

Diagnosis. Shell more or less circular, or irregularly pentagonal, generally a little longer than wide, sometimes the reverse; valves seldom equally convex, the smaller one being somewhat depressed, especially so longitudinally towards the centre, and proceeding to the front; no mesial fold or sinus; hinge lines often very wide, and nearly straight; beak more or less prominent, slightly recurved, and diagonally truncated by a large and entire foramen, partly surrounded by a deltideum in two pieces, which separates the aperture more or less from the hinge margin; beak ridges well defined, leaving between them and the hinge margin a flat triangular more or less wide area. Surface of both valves numerous and variably plicato-striated, augmenting rapidly in number from the intercalation of plaits at different distances from the beak and umbo; thus, in very young specimens, I have counted only 26 plaits on each valve, while in some adult shells their number at times exceeds 62, owing to intercalation at different distances; concentric lines of growth, often very strongly marked, intersect the longitudinal striæ. In the interior of smaller valve, the calcareous supports are doubly attached, first to the crural base, secondly to the mesial longitudinal septum, after which the ribband-shaped lamella, again extending to a short distance, bend themselves back, forming the loop. Structure punctuated.

Dimensions variable; the largest specimen noticed in England measured length 11, width 13, depth 7 lines, but in general not exceeding, length 10, width 9, depth 6 lines.

Obs. All authors seem to have agreed in preserving Sowerby's name to this elegant shell. It is very variable in shape; the plaits in some specimens being delicate and numerous, while the reverse is observable in others. The hinge line is also sometimes as wide as the shell, but it does not in general exceed two thirds; these variations will be seen in the different illustrations we have given in Plate III, figs. 29 to 33, all the specimens being from the Upper Green Sand of Horningham, Hill Deveril, near

Warminster, where it is very abundant; but I am not aware of its positively having been found in any other locality, excepting perhaps in the Chloritic Marl of Chard, where the species is, however, very rare. *T. pectita* is easily distinguished from *T. Menardi*, from its want of a mesial fold. On the Continent, *T. pectita* is found at Cap la Hève, near Havre, but we do not know it to occur at Swanage Bay, Dorsetshire, as stated by M. D'Orbigny.

Plate III, figs. 29-30. Specimens in the Collection of Mr. Cunnington, of Devizes.

Sub-Genus—TRIGONOSEMUS, *Kœnig*. 1825.

Animal fixed to rocks, or other marine bodies, by a pedicle issuing from the extremity of the beak; shell inequivalved, irregularly oval, circular, or rhomboidal, as wide as long, or longer than wide; larger valve always convex; smaller valve moderately so, flat or longitudinally depressed, beak produced, more or less recurved, and truncated by a small oval elongated foramen, beginning at the summit of the beak, and directing itself on the opposite side to the area. Area large, often nearly as wide as the shell, triangular, flat, edged and carinated exteriorly; deltideum occupying less than a third of the surface; a small portion only surrounding the foramen. Surface ornamented by numerous small radiating costæ, augmenting by intercalation at variable distances from the beak and umbo. Hinge line very obtuse, sometimes straight; valves articulating by means of two teeth in larger and corresponding condyles in smaller valve; between these last, a remarkably developed boss, or cardinal muscular fulcrum is visible, extending in some species considerably beyond the hinge line, and filling a corresponding cavity in the beak of larger valve; a short, thick, elevated, longitudinal septum, occupies about half of the length of the valve, and on either side of which two deep oval muscular impressions are visible; apophysary system or loop doubly attached; the riband-shaped lamella are first fixed to the sides of cardinal muscular fulcrum, and after proceeding to a short distance, are again attached to the highest point of the septum, before bending back on themselves to form the loop. Structure perforated, dimensions variable, the largest specimen known not exceeding 20 lines in length.¹

Obs. This genus was proposed in 1825 by Kœnig (*Icones Fossilium Sectiles*) under the following characteristic, "*Trigonosemus nob.* (Mollusca Brachiopoda) Testa inæquivalvis ovato-rotunda, valvarum altera superne producta in rostrum acuminatum S. truncatum apicæ perforatum externe convexum, interne planum; facie plana signo subtriangulari aperturam clausam indicante notata; nomen generis ex rostri signo triangulari. Fig. 73. *Trigonosemus elegans.*"

¹ The largest specimen of this genus I have seen is preserved in the collection of Mr. Morris, obtained in Cretaceous beds near Valogne. The dimensions of the smaller valve, the only one found, measures length 17, width 17 lines.

Kœnig, however, placed two other shells in his genus, which are now considered to belong to different sections or genera; *Trigonosemus elegans* must therefore be taken as the type; later, in 1847, M. D'Orbigny applied to the same shell another generic title, that of *Fissurirostra*,¹ but which cannot hold priority over the name proposed by Kœnig many years before.

The arrangements of the loop in this shell are those of *Terebratella*, to which it bears more affinity than to that of any other genus or subgenus, as admitted by M. D'Orbigny, but the shape and character of its area, beak, and foramen, as well as the remarkably-shaped boss and muscular impressions, seem to entitle it to sub-generic distinction, since differences, much less important, are very often made use of in the separation of genera in other classes of Mollusca. In some of the species, such as *Trigonosemus pulchella* and *pectiniformis*, the foramen is so very minute, as to be generally visible only by the lens, which makes M. D'Orbigny suppose, that in every adult specimen the aperture became obliterated, and that the animal lived with its smaller valve upwards, and the larger one under,—the reverse of what exists in *Terebratulæ*. I am not, however, convinced of the correctness of this observation, from having a number of specimens of both the above species before me, in all of which the foramen, although small, is perceptible; and, owing to the incurved beak, we cannot believe it was attached differently from what we observe in *Terebratulæ*. The sub-genus *Trigonosemus* seems at present peculiar to the Cretaceous period.

10. TRIGONOSEMUS ELEGANS, Kœnig. Plate IV, figs. 1—4.

TRIGONOSEMUS ELEGANS, Kœnig. *Icônes Fossilium Sectiles*, p. 3, pl. vi, fig. 73, 1825.

TEREBRATULA ELEGANS, DeFrance. *Dic. d'Hist. Nat.*, vol. 53, p. 157, 1828.

— RECURVA, „ *Dic.*, p. 161, 1828.

FISSURIROSTRA RECURVA, D'Orb. *Pal. Franç. Ter. Crétacées*, vol. iv, p. 133, pl. 520, figs. 1—8, 1847.

— ELEGANS. *Ib.*, vol. iv. p. 135, pl. 520, figs. 9—13, 1847.

TEREBRATULA ELEGANS, Bronn. *Index Pal.*, p. 1236, 1848.

— RECURVA. *Ib.*, p. 1248.

FISSURIROSTRA ELEGANS and RECURVA, D'Orb. *Prodrome*, vol. ii, p. 259, 1850.

Diagnosis. Shell inequivalve, irregularly oval, or somewhat rhomboidal, generally longer than wide; valves unequally convex, the greatest width and depth towards the middle; dental valve very convex longitudinally, keeled; beak large, much produced, moderately recurved, and obtusely truncated by a small, narrow, elongated, oval foramen or fissure, through which the pedicle issued; area very large, triangular, wider than long,

¹ 'Considerations Zoologiques et Géologiques sur les Brach.,' 'Comptes Rendus Hebdomadaires de l'Académie des Sciences,' 1847, and 'Pal. Française Ter. Crétacées,' vol. iv, p. 132.

and almost flat, carinated and edged; deltidium occupying less than a third of the width of the area, and diminishing gradually till it reaches the foramen, a very small part of which it encircles; smaller valve slightly convex, or longitudinally depressed near the front: hinge-line very obtuse and long. Valves ornamented by a great number of small rounded, radiating costæ, rarely bifurcating, but augmenting rapidly at variable distances by the intercalation of additional plaits, thus in one specimen eighteen only are seen at the umbo, thirty-three towards the middle, and fifty-six near the margin; in another at the umbo, fifteen; near the middle, thirty; at the edge, forty-four, &c.; these are likewise intersected at various distances by well-defined concentric lines of growth. Boss or cardinal muscular fulcrum much produced; loop small, doubly attached; structure punctuated; shell very thick, especially at the beak and umbo. Dimensions variable; length 11, breadth 9, depth 5 lines.

Obs. This beautiful and elegant species seems to have been first figured and described by Koenig in 1825, under the name of *Trigonosemus elegans*; about the same period it was likewise described by Defrance under that of *Terebratula elegans* and *recurva*. The typical specimens of both authors having been obtained from the Upper Chalk of the neighbourhood of Valogne. During a late visit to that locality, M. de Gerville kindly gave me many specimens of this shell of all ages, and on the examination of which I felt persuaded that M. Defrance, D'Orbigny, and Bronn are mistaken in proposing to split this type into two species, as we find every insensible gradation between those forms with a depressed smaller valve to those in which it is moderately convex; this is especially noticeable in younger shells, where the smaller valve is very often nearly flat; the form of the beak is also variable both in length and curvature. It is but lately that this species has been discovered as occurring in England, and the first knowledge of the fact I owe to Mr. Woodward, who had seen and sketched two specimens found in the Norwich Chalk by Mr. Fitch. Mr. Harris has also procured it from the chalk detritus of Charing, Kent: this species is very rare in England, only three examples having been as yet obtained; all of which will be found illustrated in our Plate IV, figs. 1, 2, 3. These specimens are beautifully preserved, and present those variations which tempted Defrance and others to propose two species. It likewise occurs in the chalk of Ciply in Belgium, also at Freville near Valognes (Dep. de la Manche).

Plate IV, figs. 1, 1^{a b}. Specimen, natural size; the largest as yet found from the Chalk of Norwich, in the collection of Mr. Fitch.

„ fig. 1^{c d}. Enlarged illustrations of the same.

„ figs. 2, 2^a. Another specimen likewise from the Chalk of Norwich, measuring length 9, breadth 8, depth 4 lines; also from the collection of Mr. Fitch.

„ fig. 3. A young specimen from the Chalk detritus of Charing, Kent, measuring length 6, width 6, depth 2½ lines, from the collection of Mr. Harris.

Plate IV, figs. 4 and 4^a. Interior of smaller valve, illustrating the arrangement of the apophysary system, from a specimen obtained near Valognes, and preserved in the collection of M. Deshayes in Paris, (enlarged.)

„ fig. 4^b. The dental valve, also enlarged.

11. *TRIGONOSEMUS INCERTA*, *Dav.* Plate IV, fig. 5.

Diagnosis. Shell of an elongated oval shape, longer than wide; valves almost equally convex: beak produced, rounded, moderately recurved, and truncated by a small oval foramen; area triangular, nearly flat, short, deltideum edging a small portion of the foramen; surface of valves ornamented by about thirty-four rounded costæ; the greater number arising from intercalation; these are closely intersected by numerous small and close concentric lines of growth. Structure punctuated; length $4\frac{1}{2}$, width 4, depth $2\frac{1}{2}$ lines.

Obs. This beautiful little shell was discovered by Mr. Moore in the Chalk with green grains of chard, where it appears very rare. It is always unsafe to establish a species on the inspection of a single specimen, which is all we have been able to obtain of the present form; but the shell seems adult, and differs much in general aspect from *Trigono- semus elegans*, being more oval, and ornamented by fewer and stronger costæ, as well as by the almost equal convexity of its valves, and straight frontal line; the area and beak are shorter, and the foramen comparatively larger. I have therefore temporarily named it *T. incerta*, hoping that the discovery of other specimens may enable Palæontologists to fix its real place with greater certainty.

Plate IV, fig. 5. Specimen, nat. size, from the collection of Mr. Moore.

„ fig. 5^{a b c}. Enlarged illustration of the same.

Sub-Genus—TEREBRIOSTRA, *D'Orbigny.* 1847.

Shell generally elongated, more or less oval, inequivalve, the dental valve much longer than the smaller or socket one, extending in the shape of a long beak, with a flat, false area and narrow deltideum; the foramen truncating the extremity of the beak, and partially completed by the deltideum; hinge articulating by means of two teeth in larger and corresponding condyles in smaller valve; internal disposition of the calcareous supports unknown; a mesial longitudinal plate is seen in the interior of smaller valve, probably destined to support a doubly-attached loop; structure punctuated.

Obs. This sub-genus is at present characterised so very unsatisfactorily, from our ignorance as to its internal disposition, that it is with great difficulty I have been able to make up my mind even to its temporal admission in this Monograph. I do so in hope that the

discovery of its complete interior will soon permit Palæontologists to ascertain its true position. It is possible that eventually it may turn out to be only a *Terebratella*,¹ or have a disposition of loop peculiar to itself, as we do not consider a beak being more or less elongated of sufficient generic value. Many authors, however, seem disposed to separate the shells in question from the true *Terebratulæ*, and they may probably prove distinct. Thus, Mr. Sowerby states that Mr. Cumberland had called it *Lyra Meadi*; but, finding the term *Lyra* so apt, he could not resist applying it to the specific name. Later (1825) Kœnig, in his 'Icones Fossilium Sectiles,' placed it in his *Trigonosemus*, naming first, *T. elegans*; secondly, *T. rustica*; and thirdly, *T. lyra*, as types and examples. All these, however, have subsequently been placed in distinct genera, and we have preserved the name of *Trigonosemus* to the first, which corresponds to M. D'Orbigny's genus *Fissurirostra*. Few authors, excepting Mr. Brown,² have applied Kœnig's generic appellation to *T. lyra*, and it was only in 1847 that M. D'Orbigny proposed his genus *Terebrirostra*.³ In England, we are only acquainted with one species, the *Terebrirostra lyra*.

12. TEREBRIROSTRA LYRA, Sow. Sp. Plate III, figs. 17—28.

Encyclop. Méth. Pl. 243, fig. 1, 1789.

TEREBRATULA LYRA, Sow. Min. Con., vol. ii, p. 87, tab. 138, fig. 2, 1818.

— — Lamarck. An. sans Vert., vol. vi, p. 255, No. 49, 1819.

— — Conybeare and Phillips. Outlines of the Geol. of England and Wales, p. 130, 1822.

— — Parkinson. An Introduction to the Study of Organic Remains, p. 234, 1822.

— — Kœnig. Icones Fossilium Sectiles, p. 4, pl. vi, fig. 77, 1825.

TRIGONOSEMUS LYRA, Kœnig. Ibid., p. 4, pl. vi, fig. 76, 1825.

TEREBRATULA LYRA, Smith. Strata identified by Organised Fossils, fig. 3, 1816—27.
(As this work appeared at different epochs, I do not know the exact date of this species.)

— — Defrance. Dic. des Sc. Nat., vol. liii, p. 160, pl. lxii, fig. 7, 1828.

¹ In the 'Journal de Conchiliologie,' No. 11, p. 223, 1851, M. D'Orbigny states his acquaintance with five species of *Terebrirostra*, viz. *T. neocomiensis*, *T. arduennensis*, *T. lyra*, *T. Bargesana*, and *T. canaliculata*. Another most beautiful and well-characterised form, from the Chalk of Ciply, is known to me. One of M. D'Orbigny's so-called species, the *T. canaliculata* of Rœmer, is a true *Terebratella*, and somewhat resembles such species as *T. Menardi* and *T. pectita*, the loop is doubly attached, and disposed exactly as we see in the types of the genus *Terebratella*. The position of the foramen relative to the extremity of the beak is different from *T. lyra* and its associates; and we cannot but feel surprised at M. D'Orbigny proposing to place Rœmer's species in his genus *Terebrirostra*.

² 'Illustrations of Fossil Conch. of Great Britain,' 1838.

³ 'Considerations Zoologiques et Géologiques sur les Brachiopodes,' 'Comptes Rendus Hebdomadaires de l'Académie des Sciences,' Août, 1847.

- TEREBRATULA LYRA, *Deshayes*. Ency. Méth., vol. iii, p. 1029, 1832.
 — — *V. Buch*. Uber Ter., 1834, et Mém. de la Soc. Géol. de France,
 vol. iii, 1st ser., p. 173, pl. xvi, fig. 17, 1838.
 — — *Deshayes*. Nouv. Ed. de Lamarck, vol. vii, p. 344, No. 49, 1836.
 — — *Deslongchamps*. Soc. Linn. de Normandie, 1837.
 — — *D'Archiac*. Obs. sur le Groupe Moyen de la Forme Crétacée, Mém.
 Soc. Geol. Fos., p. 295, vol. iii, 1839.
 TRIGONOSEMUS LYRA, *Brown*. Illustrations of Foss. Conch. of Great Britain, pl. xlix,
 figs. 5, 13, 1838.
 TEREBRATULA LYRA, *Morris*. Catalogue, 1843.
 — — *Raulin*. Patria la France Ancienne et Moderne, p. 362, fig. 100, 1844.
 TEREBRIOSTRA LYRA, *D'Orb*. Pal. Franç. Ter. Crétacées, vol. iv, p. 129, pl. 519,
 figs. 11, 19, 1847,
 TEREBRATULA LYRA, *Dujardin*. Dic. Universelle d'Hist. Nat. Mollusques, pl. ix,
 figs. 5-6, 1848.
 TEREBRATULA LYRA, *Bronn*. Index Pal., p. 1241, 1848. (But not his Synonyms,
 which are very defective.)
 TEREBRIOSTRA LYRA, *D'Orb*. Prodrôme, vol. ii, p. 173, 1850.
 — — *D'Orb*. Journal de Conchyliologie, vol. ii, p. 224, 1851.

Diagnosis. Shell inequivalve, of an elongated, irregularly oval shape, moderately convex, rather compressed in the middle; beak much produced and elongated, very often exceeding in length the remaining portion of the shell, straight or gently curved, while tapering gradually to its extremity, which is truncated by a rather small transversely oval foramen, partly completed by a long and narrow deltideum, longitudinally depressed, and extending from the extremity of the beak to the hinge-margin; on either side a well-defined, almost flat, false area is perceptible.

Smaller valve oval or irregularly pentagonal, tapering at the umbo, widest near its middle, slightly curved or straight in front; valves ornamented by a great number of diverging, irregularly-disposed rounded costæ, sometimes bifurcating, more commonly augmenting by numerous intercalated plaits at different distances from the beak and umbo; these are intersected by concentric lines of growth, more numerous near the margins. The internal dispositions of the calcareous supports are as yet unknown; structure punctuated; dimensions variable. Length of the largest specimen 2 inches 3 lines, width 10, depth 7 lines.

Obs. This is one of the most beautiful among the Brachiopoda, and is much sought after by collectors, from its elegant shape as well as its rarity: the great length of its beak is one of its most striking features; as we have already stated, it often exceeds considerably the remainder of the shell, especially in young individuals; but, as judiciously observed by M. D'Orbigny, it seldom extends with age; on the contrary, the pallial portion becomes more elongated as well as augmented in width, so that in the generality of adult specimens the body of the shell exceeds the dimensions of the beak. The form and arrangement of the costæ are likewise very remarkable; they are rarely straight, except in the young, but

are irregularly waving; the few central ones extending almost in a direct line to the front, but the lateral costæ, particularly in older shells, seem to lie more against the central ones, and augment rapidly by bifurcation and intercalation at different distances and periods of growth. All we know of its interior is, that the valves articulate by the means of two teeth in the larger and corresponding sockets in the smaller valve; the beak seems to be hollow, and strengthened by two slender plates situated at the base of the teeth, and dividing it into three unequal partitions, as may be seen by the section I have given of the beak at half its length (Pl. III, fig. 25); these Plates, however, seem gradually to approach the lateral portions of the beak, leaving the foramen entirely surrounded by its substance and deltideum, as seen in fig. 28; in the interior of the smaller valve the boss or cardinal muscular fulcrum, fig. 27^b, is somewhat produced, and a short elevated longitudinal septum extends to less than half the length of the valve. Whether the loop was simply attached to the crural base, as in true *Terebratulæ*, or doubly attached as in *Terebratella*, or otherwise disposed, is still a matter of conjecture.

Ter. lyra has hitherto been found but in a few localities; viz., in the Upper Green Sand at Chute Farm, near Horningham, where it is far from being common; also still more rarely in the Chalk, with green grains, of Chardstock, in which locality it was discovered by Mr. Bunbury, some years ago. On the Continent it is found in the Upper Green Sand, or Chloritic Chalk of Cap la Hève, near Havre, whence no doubt the first specimen, figured in 1789 in the 'Ency. Méth.,' was obtained.

All our illustrations in Pl. III are from specimens belonging to the Upper Green Sand from the neighbourhood of Warminster, figs. 17, 18, 19, 20, belonging to the Collection of Mr. Falkner, of Devizes; fig. 26 from that of Mr. Cunnington.

Genus—TEREBRATULINA, *D'Orb.* 1847.

Animal fixed to submarine bodies by means of a pedicle passing through the foramen of the beak in larger valve, edges of the mantle free, body small. Shell punctuated, inequivalve, variously shaped, generally longer than wide, and more or less oval; beak obliquely truncated by the foramen, which is large, and extending to the umbo deltideum often small and indistinct; smaller valve less convex than the perforated one, with two more or less developed auricle expansions. Surface generally striated or costellated. Valves articulating by the means of two teeth in the larger, and sockets in the smaller valve; apophysary system short, not exceeding one third of the length of the shell, and formed of two short stems simply attached to the extremity of the socket ridges, which, after converging, are united by a lamella in the shape of a small square tubular ring bent upwards in front; on the sides of these are fixed the free fleshy arms of the animal which extend to near the frontal margin, and bent back in the shape of a loop. The outer edges are covered by long cirri.

Obs. I have only found two species of British Cretaceous *Terebratulina*; the genus existed during the Oolitic, Cretaceous, and Tertiary periods, and is still abundant in the recent state.

13. *TEREBRATULINA STRIATA*, *Wahlenberg*, Sp. Plate II, figs. 18, 28.

Faujas St. Fond. 'Hist. de la Montagne de St. Pierre de Maestricht.' pl. xxvi, figs. 7 and 9, 1799.

TEREBRATULITES CHRYSALIS, *Schlotheim*. Beiträge zur Nat. Vers., in Leonhard's Min. Taschen., vol. vii, p. 1813, (ref. to *Faujas* fig., pl. xxvi, fig. 7.)

— *TENUISSIMA*, *Schlotheim*. Ib. (ref. *Faujas* fig., pl. xxvii, fig. 7.)

— *CHRYSALIS*, *Schlotheim*. Die Petref., p. 39, 1820, (ref. *Faujas*, pl. xxvi, figs. 7, 9.)

ANOMITES STRIATA, *Wahlenberg*. Petrificata Telluris Suecanæ Examinata, in Nova Acta Regiæ Soc. Scien. Upsaliensis, vol. viii, p. 61, 1821, (no figure.)¹

TEREBRATULA DEFRANCII, *Brongniart et Cuvier*. Desc. Géol. des Env. de Paris, p. 383, pl. iii, fig. 6, 1822.

— *STRIATULA*, *Mantell*. Geol. of Sussex, pl. xxv, figs. 7, 8, 12, 1822.

— *PENTAGONALIS*, *Phillips*. Illustrations of the Geol. of Yorkshire, Part I, pl. i, fig. 17, 1825.

— *STRIATULA*, *Phillips*. Ib., pl. ii, fig. 28.

— — *Sowerby*. Min. Con., vol. vi, p. 69, pl. 336, figs. 3, 4, 1829, (fig. 5 is the London Clay species, to which we preserve the name of *Striatula*, equally given to that shell by *Sowerby*.)

— *DEFRANCII*, *Nilsson*. Petrefacta Suecana, p. 35, pl. iv, fig. 7, 1827.

— — *Dalman*. Acad. Handl., p. 52, 1827.

— *DEFRANCII*, *Defrance*. Dic. des Sciences Nat., vol. liii, p. 163, 1828.

— *GERVILLIANA*, *Defrance*. Ib., p. 157, 1828, (is only a young specimen.)

GERVILLEI, *Woodward*. An Outline of the Geol. of Norfolk, tab. vi, fig. 14, 1833.

— *STRIATULA*, *V. Buch*. Uber. Ter., 1834, and Mém. de la Soc. Géol. de France, vol. iii, 1st ser., p. 164, pl. xvi, fig. 7, 1838.

— *DEFRANCII*, *V. Buch*. Ib., p. 165, pl. xvi, fig. 8, 1838.

— *CHRYSALIS*, *V. Buch*. Ib., p. 166, pl. xvi, fig. 9, 1838.

— *STRIATULA*, *Deshayes*. Nouv. Ed. de Lamarck, vol. vii, p. 360, 1836.

— *DEFRANCII*, *Deshayes*. Ib., p. 367.

— — *Hisinger*. Leth. Suecia, p. 78, tab. xxii, fig. 10, 1837.

— *CHRYSALIS*, *Bronn*. Leth. Géog., p. 651, pl. xxx, fig. 6, 1837.

— *STRIATULA*, *Geinitz*. Charakteristik der Kreidegebirges, p. 14, 1839.

— *DEFRANCII*, *Rüemer*. Die Vers. Nord. Kreid., p. 40, 1840.

¹ Described as follows: "*An. striata*, superfici ubique longitudinaliter striata conca subcuneiformis, nate brevi ampla—e Bahlsberg allatus longitudini sesquipollicari."

- TEREBRATULA STRIATULA, *Ræmer*. Die Vers. Nord. Kreid., p. 39, 1840.
 — FAUJASII, *Ræmer*. Ib., p. 40, tab. vii, fig. 8, 1840.
 — AURICULATA, *Ræmer*. Ib., p. 39, tab. vii, fig. 9, 1840.
 — CHRYSALIS, *Ræmer*. Ib., p. 40, 1840.
 — STRIATULA, *Geinitz*. Char. Petref. Kreid., pl. xvi, fig. 12, 1840.
 — CHRYSALIS, *Bronn*. Leth. Geog., p. 651, pl. xxx, fig. 6, 1837.
 — STRIATULA, *Morris*. Catalogue, 1843.
 — — *D'Orb.* Russia and Oural, vol. ii, p. 493, pl. xliii, figs. 18—20, 1845.
 — — *Reuss*. Die Vers. der Böhemischen Kreideformation, p. 49, pl. xxvi, fig. 2, 1836.
 — CHRYSALIS, *Reuss*. Ib., p. 49, pl. 26, fig. 3.
 — FAUJASII, *Reuss*. Ib. p. 50, pl. xxvi, fig. 4.
 TEREBRATULINA STRIATA, *D'Orb.* Pal. Franç. Ter. Cretacées, vol. iv, p. 65, pl. 504, figs. 9—17, 1847.
 TEREBRATULA DEFRANCI, *Bronn*. Index. Pal., p. 1234, 1848.
 — CHRYSALIS, *Bronn*. Ib., p. 1232.
 — — *Dav.* Lond. Geol. Journal, pl. xviii, figs. 18, 20, 1847.
 — STRIATULA, *Dixon*. The Geol. and Fossils of the Ter. and Cret. Form. of Sussex, pl. xxvii, fig. 21, 1850.
 TEREBRATULINA STRIATA, *D'Orb.* Prodrome, vol. ii, p. 358, 1850.

Diagnosis. Shell variable in shape according to age; irregularly oval or pentangular, tapering at the beak, longer than wide; valves slightly and almost equally convex, sometimes presenting a slight longitudinal depression on each valve, beginning at about half the length of the shell, and extending to the front, which is at times more or less indented, or forms a regular outward curve, no traces of indentation being visible; beak short, obliquely truncated by a moderately sized foramen, formed partly out of the substance of the beak, and by two small deltideal plates on either side; the anterior portion being in general completed by the umbo. Beak ridges indistinct, sloping rapidly off, giving the beak a tapering appearance; auricles on either side of the umbo very large and straight in the young shells, small and oblique in the adult, and sometimes disappearing almost from the convexity of this portion of the valve. Surface ornamented by a variable number of radiated, small, elevated striæ; few in number, and granulated in the young; very numerous and smooth in the adult, augmenting rapidly at a short distance from the umbo and beak by bifurcation, but more generally by intercallation. Concentric lines of growth more or less marked; internal calcareous supports short and anneliform; structure punctuated; dimensions variable; our British specimens do not seem to exceed length 11, width 8, depth $4\frac{1}{2}$ lines.

Obs. Many species have been made out of different ages of this variable shell, as may be perceived by a glance at the list of synonyms; having compared and studied a multitude of specimens of all ages of this form, from the size of a quarter of a line to near one inch in length, I feel satisfied that all those hitherto found in England belong to, and are mere variations of, one single type, scarcely distinguishable from the recent *Ter. caput-*

serpentis; this last seems, however, a deeper shell; but there is no difference that I can perceive in the striæ or internal details of the apophysary system. Most Palæontologists strongly object to the idea of a Cretaceous species being found recent, and although we are not convinced that such a thing is impossible, we have not been able to bring ourselves to a positive admission of the fact as certain. The tertiary species to which we have preserved the name of *Striatula* appears to us more distinct from the recent and Cretaceous form, than this last is from the recent. *T. striatula* is wider and more circular at the beak and umbo, and does not seem to taper away as in the other forms. I have experienced much difficulty in making up my mind as to what name this species should preserve, so many having been proposed by various authors.¹ I have at last decided to follow M. D'Orbigny, in adopting that of *T. striata*, described, but not figured, by Wahlenberg in 1821, although this name had been given by Brocchi in 1814² to another species illustrated by Soldani in 1780,³ but on examining the very bad figure of this last-named author, it would be difficult to ascertain the type intended. It must also be remarked that several years before Wahlenberg, Schlotheim, in 1813, had given various names to young specimens and malformations, figured, but not named, by Faujas in 1799, such as *Ter. chrysalis*. This appears to be a malformation of a young specimen of *Ter. striata*, but not understood by most authors who have contented themselves to preserve and reproduce Faujas' figure, with all its defects. At the same period, Schlotheim likewise gave to another figure of Faujas the name of *T. tenuissima*. This is only another variation in age of the same form; and, as these do not illustrate in a satisfactory manner the shell in question, I think it preferable to adopt that of Wahlenberg. I am not astonished at early naturalists not having perceived the real difference presented by age in this species, but I am surprised that many modern authors should have quite lost sight of this character. I therefore believe the *Ter. striatula* of Mantell, *Defranci* of Brongniart, *Gervilliana* of DeFrance, *Pentagonalis* of Phillips, *Faujasii* and *Auriculata* of Roemer, *Gervillei* of Woodward, and other names above mentioned, must all merge into one species, viz., *T. striata*. It is very probable, that one or two of the species lately proposed by M. D'Orbigny will require to be added to the synonyms. I have come to the above conclusion, but in which I may be mistaken, after a long and minute examination of several hundred specimens from various beds, localities, and countries. In England, we have not yet found any of those very adult specimens known under the appellation of *Defranci*, which are rare everywhere; at Meudon, the chalk is full of young

¹ It is stated in M. Fischer's and Waldheim's 'Ortyctographie du Gouvernement de Moscow,' 1830—37, that Dr. Mantell's *Ter. striatula* is a synonym of *Ter. scabra* (Fischer), described and figured by that author in 1809 ('Notice des Fossils du Gouv. de Moscow,' pl. ii, figs. 1 and 2); but, on examining the memoir just noticed, I must confess that no one could identify the shell figured with *T. striata*. *T. scabra* cannot, therefore, be taken as the type of the species under notice.

² Brocchi, 'Conchologia Fossile,' p. 466, No. 18, 1814, *Anomia striata*.

³ Soldani, 'Saggio Orittografico,' Sienna, 1780, tab. xvi, fig. 82, o. p.

shells, but it is only now and then that a large adult specimen is discovered. With age the striæ do not seem to augment much in width; on the contrary, they are many times larger in proportion in the young.

T. striata is found in the Upper and Lower Chalk of Kent, Sussex, and Norfolk; in the Upper Green Sand near Warminster; and in the Speeton Clay of Knapton, on the Yorkshire Coast. At one time, I thought the Upper Green Sand specimens might belong to another species, from being generally more elongated and rarely notched or indented in front, this portion forming a regular outward curve; but, having found, in the Lower or Grey Chalk, near Dover, many examples quite identical with those from the Upper Green Sand, I determined to give up that idea. I will not offer so decided an opinion relative to the form found in the Speeton Clay, having been able to study only one specimen, lent me by Mr. Bean, and which apparently presents some variations; and, if constant, they would entitle it to a separate appellation. It much resembles the figure which M. D'Orbigny gives of *Ter. Companiensis*. This last-named shell is, however, always adult, with much smaller dimensions. On the Continent, *T. striata* is met with in the same stratigraphical range as in England, and is common to many localities. In Plate II, I have endeavoured to illustrate the principal variations that I have observed in the British specimens.

Fig. 18. From the chalk of Norwich, in the collection of Mr. Fitch. 18'. Enlarged illustration.

Fig. 19. Illustrates the interior and annular apophysary process, from a specimen in my collection.

Figs. 20, 21, 22, 23, 24. Young shells, from the Upper and Lower Chalk of Kent, principally from the collection of Mr. Harris.

Fig. 25. A specimen from the Gray Chalk, in the vicinity of Dover.

Fig. 26. From the Speeton Clay of Yorkshire, in the collection of Mr. Bean.

Figs. 27, 28. Two specimens from the Upper Green Sand near Warminster, from the cabinet of Mr. Cunnington.

14. TEREBRATULINA GRACILIS, *Schl.* Sp. /Plate II, figs. 13—17.

TEREBRATULITES GRACILIS, *Schlotheim*. 1813. Beiträge zur Naturgeschichte der Versteinerungen in Leonhard's Min. Tasch., vol. vii, p. 112, tab. iii, fig. 3.

— — *Schloth.* Die Petrefactenkunde, p. 270, No. 35, 1820.

TEREBRATULA RIGIDA, *Sowerby*. Min. Conch., vol. vi, p. 69, tab. 536, fig. 2, 1829.

— GRACILIS, *Schlotheim*. Syst. Vers. der Petrefacten., 1832.

— — *Von Buch*. 1834. Über Terebrateln, 1838; and Mém. Soc. Géol. de France, vol. iii, 1st ser., p. 167, pl. xvi, fig. 11.

— — *Geinitz*. Charak. der Schichten und Petrefac. der Säch. Kreidegebirges, 1839, p. 14, No. 4; and in 1840, pl. xvi, fig. 13.

- TEREBRATULA GRACILIS, *Ræmer*. 1840. Die Vers. Norddeutschen Kreidgebirges, p. 40, No. 27.
- — *V. Hagenow*. Mon. der Rüg. Kreid. Vers., 1842.
- RIGIDA and GRACILIS, *Morris*. Catalogue, 1843.
- GRACILIS, *Geinitz*. Grundriss der Verst., pl. xxi, fig. 10, 1844.
- TEREBRATULINA GRACILIS, *D'Orbigny*. Geol. of Russia and Ural, vol. ii, p. 499, pl. xliii, figs. 24—26, 1845.
- TEREBRATULA GRACILIS, *Reuss*. Die Vers. der Böhemischen Kreideformation, p. 49, pl. xxvi, fig. 1, 1846.
- TEREBRATULINA GRACILIS, *D'Orbigny*. Pal. Française Ter. Crétacées, vol. iv, p. 61, pl. 503, figs. 1—6, 1847.
- TEREBRATULA GRACILIS, *Bronn*. Index Pal., p. 1237, 1848.
- TEREBRATULINA GRACILIS, *D'Orb.* Prodrome, vol. ii, p. 198, 1850.
- TEREBRATULA GRACILIS, *C. Puggaard*. (Géol. de l'Ile de Möen.) Bull. de la Soc. Géol. de Fr., vol. vii, p. 534, 1850.

Diagnosis. Shell inequivalve, orbicular, circular or elongated, either wider than long or longer than wide; larger or dental valve always convex; the smaller one either moderately so, or flat, never gibbous; beak not much produced; foramen small, formed partly out of the substance of the beak, and by two small lateral deltidial plates, the anterior portion being completed by the umbo; beak ridges well defined, leaving between them and the hinge line a flat space or false area; auricles on either side of the umbo rather small; valves ornamented by a variable number of radiating elevated striæ, often granulated, which, soon after leaving the beak and umbo, augment rapidly in number, rarely from bifurcation, but almost always by the intercalation of smaller costæ, at variable distances between the larger ones, and extending to the front and lateral margins; concentric lines of growth more or less prominent; structure punctuated; internal calcareous supports short and anneliform. Dimensions variable: length $5\frac{1}{4}$; width 5; depth 2 lines. The comparative depth in some specimens is greater than is here given.

Obs. Schlotheim, in 1813, appears to have been the first author who noticed and figured this species, stating it to occur in England; and it is the same as that described later, from the Chalk near Norwich, by Sowerby, under the appellation of *Ter. rigida*. It appears, likewise, to have been one of those fortunate forms, to which the generality of authors have applied the original name, notwithstanding its great variability in the convexity of its valves and the number of its plaits, the last varying from eighteen to fifty on each valve, round the edge. The costæ, also, are not of equal width and depth, as almost invariably, between two larger ones, one, two, or three smaller costæ intervene, appearing at different distances from the beaks, and extending to the front. It is, therefore, owing to the greater or less number of these intervening plaits that the shell becomes more closely or widely striated. It does not, however, present as much difference in the young state as we discover in *T. striata*, and from this last is always easily distinguished by its much more circular form and greater comparative width, as well as by the general aspect of the shell.

In England, *T. gracilis* is very abundant in the Upper and Lower Chalk of many localities; thus, at and between Dover and Folkstone, Mr. Mackie, myself, and others have found it in both the Upper and Lower Chalk; at Charing, Kent, it has been obtained from the chalk detritus by Mr. Harris; likewise in the Sussex Chalk by Mr. Catt. Mr. Bowerbank has it from the Chalk of Trimmingham; Messrs. Fitch, Woodward, and others, from that of Norwich; and Mr. C. B. Rose informs me, that he has found it in the Blue Gault of West Norfolk. I have not seen any specimens from the Gault of the South of England, nor from either the Upper or Lower Green Sand: its vertical range seems much smaller than that of *T. striata*.

On the Continent, *T. gracilis* is likewise abundantly distributed, and its principal varieties have been figured by Schlotheim, Sowerby, Roemer, V. Buch, Geinitz, Reuss, and D'Orbigny.

Plate II, fig. 13. A specimen, with the smaller valve almost flat, very slightly convex, only at the umbo, from the Chalk of Trimmingham, in the collection of Mr. Bowerbank. Similar specimens are also preserved in the York Museum.

„ fig. 14. A remarkably fine specimen, the smaller valve being almost flat, from the Chalk near Norwich, in the collection of Mr. Fitch.

„ fig. 15. The interior of the smaller valve, from Dover, in my collection.

„ fig. 16. A variation, in which the smaller valve is slightly convex, from the Chalk of Dover.

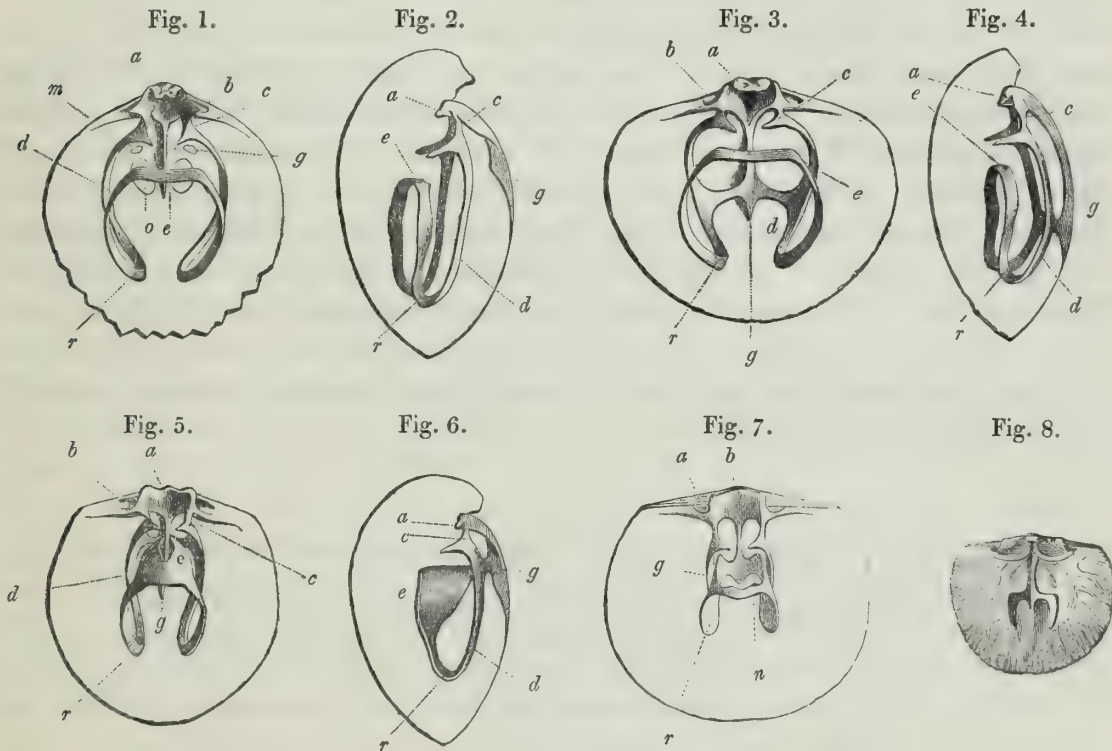
„ fig. 17. A very convex variation, also from the Kentish Chalk, illustrating the greatest number of striæ I have noticed in the species.

Sub-genus—KINGENA, Dav. 1852.

Animal fixed to submarine bodies by means of a pedicle; shell inequivalve, more or less circular or ovate; valves convex; beak moderately produced, recurved; foramen circular, partly completed by a deltidium in two pieces, not always visible, from the foramen lying close to the umbo. Structure punctuated, surface variously ornamented by granular spinose or squamose unequal asperities irregularly disposed. Beak ridges well defined, leaving a false area between them and the hinge margin, valves articulating by means of two teeth in the larger and corresponding sockets in the other valve. In the interior of smaller valve, a deep hollow crura, or muscular fulcrum, widely separates the inner socket walls; no produced boss; a small deep depression lies along the centre of the crura, giving rise to a short elevated mesial longitudinal septum not extending further than half the length of the valve. On either side of the crural base two riband-shaped lamellæ are fixed; these, after proceeding a short distance, throw off a lateral process which attaches itself to the sides of the central septum, at a short distance from its origin;

the lamellæ extend again to about two thirds of the length of the valve; when, bending back upon themselves, they form a large wide loop, and, after leaving a very small free space just above the septum, are likewise fixed on either side to the central septum above the under pair.

Obs. The remarkable character and disposition of the lamellæ in this form, induces me to propose a subgeneric title, as such shells could not with propriety be placed in any of the sections now in use; and to afford greater facilities of comparison, I have introduced some illustrations of different sections of the family *Terebratulidæ*:



Figs. 1 and 2 represent the interior of *TEREBRATULA Australis*: in this the loop is simply attached to the crural base, the ribband-shaped lamellæ forming throughout a free and slender loop, extending into the cavity of the valve.

Figs. 3 and 4, *TEREBRATELLA Chilensis*: here the loop is doubly attached, first to the crura, then again to the central longitudinal septum, before proceeding forth, and bending back, to form a free slender loop, as in *Terebratula*.

Fig. 7, *MEGERLIA truncata*: a slightly elevated medio-longitudinal crest proceeds from under the muscular fulcrum (*a*) to less than half the length of the valve, near the extremity of which (*g*) two short central diverging branches arise (*n*) and support the calcareous loop, which consists of two ribband-shaped lamella first attached to the inner side of the socket walls or crural base, afterwards extending to the extremity of the diverging branches (*n*) to which they are affixed before proceeding on both sides in the same direction to their

extremity (*r*) under the shape of two nearly parallel longitudinal lamellæ; the inner ones are very wide, and joined by a narrow arched process; the loop is therefore three times attached on either side.

Fig. 8 illustrates the genus *KRAUSSIA*¹ *rubra*, (Pallas, Sp.) Here the internal calcareous appendages consist only of two central diverging branches, somewhat spread out at their ends.

Figs. 5 and 6 illustrate *KINGENA lima*, as well as fig. 15, Pl. IV. The last is viewed more in front, to show the connection of the four branches or lamellæ affixed to the septum. The structure of the exterior, as well as the difference observable in the interior, would not allow of *Kingena lima* being placed in the same section as *Terebratella*; in the latter, there exists always a more or less produced and distinct muscular fulcrum or boss, which does not occur in either *Kingena* or *Megerlia*, where, on the contrary, a cavity or depression is visible. I am only acquainted with the interior of one species, the *Terebratula lima* of DeFrance. It is probable that *Ter. ovata*, Sowerby; *T. rugulosa*, Morris; and *T. squamosa*, of Mantell, may belong to the same sub-genus; but, not being acquainted with their interiors, I think it for the present preferable to leave them under the genus *Terebratula*, whence they may be removed when future discoveries will have made known their internal arrangements. I have dedicated this sub-genus to Professor King, whose researches have brought to light many interesting points connected with the history of this most difficult class of Mollusca.

15. *KINGENA LIMA*, DeFrance, Sp. Plate IV, figs. 15—28, and Pl. V, figs. 1—4.

- TEREBRATULA *LIMA*, DeFrance. Dic. d'Hist. Nat., vol. liii, p. 156, 1828.
- PENTANGULATA, Woodward. An Outline of the Geol. of Norfolk, tab. vi, fig. 10, 1833.
- *LIMA*, D'Orbigny. Pal. Franç. Ter. Crétacées, vol. iv, p. 98, pl. 512, figs. 1—5, 1847.
- HEBERTIANA, D'Orbigny. Ib., p. 108, pl. 514, figs. 5, 11, 1847.
- SPINULOSA, Morris. Annals and Mag. of Nat. Hist., vol. xx, Oct., 1847, p. 253, pl. xviii, figs. 6, 6^a.
- *LIMA*, Bronn. Index. Pal., p. 1240, 1848.
- SEXRADIATA, Sow. in Dixon. The Geol. and Fossils of the Ter. and Cret. Form. of Sussex, pl. xxvii, fig. 10, 1850.
- HEBERTIANA, D'Orb. Prodrôme, vol. ii, p. 258, 1850.
- *LIMA*, D'Orb. Ib., p. 172, 1850.
- — Guéranger. Bull. Soc. Géol. de France, vol. vii, p. 803, 1850.

Diagnosis. Shell inequivalve, circular, oval, or irregularly pentagonal; as wide as long, or wider than long; valves more or less convex; larger or dental valve most so; beak

¹ Genus *Kraussia*, Dav. 1852; five recent species are known, *K. rubra*, *K. natalensis*, *K. pisum*, *K. cognata*; the genus has not been noticed in the fossil state.

short, much recurved, and truncated by a middle sized foramen, generally lying close on the umbo, so that little or none of the deltidium is seen ; but when exposed, especially in young shells, it is composed of two plates, generally lateral and disunited ; a small portion of the circumference being completed by the umbo ; beak ridges well defined, exhibiting a flat or concave false area between them and the hinge margin ; smaller valve less convex than the dental one, no mesial fold or sinus perceptible, but the margin line in front presents at times a slightly elevated curve. Structure punctuated and irregularly covered by a multitude of small granulations or short hollowed spines, often very large in comparison with the dimensions of the shell, and closely or more widely separated. The largest British specimen yet found, measures, length 12, width 12, depth 7 lines ; others, length 9, width 6, depth 5 lines, &c.

Obs. This interesting shell has given me great trouble from the variability of its shape, and it was not before having minutely examined with much care a vast number of specimens, that I came to the conclusion, that this species existed in the Upper Green Sand, Gault, Lower and Upper Chalk ; its stratigraphical and vertical range is therefore very great. Secondly, that *Ter. pentangulata* of Woodward, *Ter. Hebertiana* of D'Orbigny, *Ter. sexradiata* of Sowerby, *Ter. spinulosa* of Morris, are all variations of one and the same type, viz., *Ter. lima* of DeFrance. The interior of all are exactly similar ; the structure the same, as well as all the other characters, though these may be slightly modified in appearance in some beds and localities, owing to the matrix and other local causes ; for example, if we take a small or young specimen of *Ter. lima* of DeFrance, and compare it with a large specimen of *Ter. pentangulata* of Woodward, we perceive an apparent difference, but this is also seen in all extremes of any variable form ; but if, however, we have a great number of specimens of the same species they will soon fill up all the links separating the two extremes by insensible passages, and this is just what I have found in *T. lima*, from the study of more than a hundred specimens obtained from the different deposits above alluded to ; in the young, the shell is often somewhat compressed, but in all adult individuals it is more or less convex. To afford facility of comparison, I have given in Plates IV and V no fewer than forty-four figures from specimens found in all the beds mentioned, and from different localities ; which I have carefully compared with the types found in the Green Sand of Havre, whence DeFrance's original types were obtained. M. D'Orbigny does not appear to have noticed the fact, that on well-preserved shells of his so-called *Ter. Hebertiana*, the same granular spinose asperities noticed in *Ter. lima* do exist ; all his specimens were worn on their surface, and only the punctuations visible, which he states to be strongly marked with checkerwise spaces between. Mr. Woodward first called my attention to the granulation in some from the Chalk of Norwich, and since then, I owe to the kindness of Mr. Fitch, a beautiful series, showing that it was as entirely and as closely covered, as any specimen from the Upper Green Sand. Let any observer compare for illustration, Pl. IV, figs. 21 and 22, from the Upper Green Sand, with figs. 19 and 20, the types of *Ter. pentangulata*, from the Norwich Chalk, and they will be at a loss

to assign any differences; again Pl. II, fig. 3, from the Gault of Folkstone, is undistinguishable from the Chalk and Upper Green Sand forms; figs. 23 and 25 of Pl. IV are the same as found by DeFrance, in the Green Sand of Havre, in France, and named by him *Ter. lima*; if any of these variable shapes had proved constant in any of the above sedimentary deposits, we might have supposed them distinct, but in one, as well as in all, the same variations are perceptible, and the only difference being that of colour, arising from the matrix wherein they have been imbedded, which is white in the Chalk, grey or blue in the Gault, and grey-yellowish or dirty-white in the Upper Green Sand. Such are my views; I may, however, be mistaken. The fortunate discovery of perfect interiors, both from the Chalk and Upper Green Sand, was a circumstance unknown to M. D'Orbigny, that author's figure in 'Pal. Fran.,' Pl. 514, fig. 8, being incomplete and incorrect.

Plate IV, figs. 21, 22, and 25. From the Upper Green Sand of the neighbourhood of Warminster, nat. size, in the collection of Mr. Cunnington; fig. 22 is the largest specimen I have seen.

- „ V, fig. 4. Is a specimen from the Upper Green Sand of Cambridge, in the collection of Mr. Carter, in this locality, as well as at near Warminster; many varieties of shape are perceptible, of which our space does not permit of illustration.
- „ IV, fig. 23. A specimen from the Chloritic Chalk of Chard, from the collection of Mr. Moore. Mr. Morris has similar specimens from Chaldon; and the same may be seen in the British Museum, from Havre, in France.
- „ fig. 24. The original specimen of *Ter. spinulosa* (Morris), from the Gault of Folkstone, now in my collection.
- „ fig. 24^c. An enlarged illustration; we have also other specimens of this shell from the same Gault, proving the identity with those from the Upper Green Sand and Chalk.
- „ V, fig. 3. Is likewise from the Gault of Folkstone.
- „ fig. 3^c. An enlarged illustration.
- „ fig. 1. From the Grey Chalk, Maidstone, in the collection of Mr. Morris.
- „ fig. 1^a. An enlarged illustration. This is an exceptional form.
- „ fig. 2. From the same bed, between Folkstone and Dover.
- „ IV, fig. 15. From the interior of the smaller valve of a specimen from the Upper Chalk, near Norwich. Mr. Carter has a similar specimen from the Upper Green Sand of Cambridge. See also woodcut, figs. 5 and 6, in the Text.
- „ fig. 16^a. A very young specimen from the Upper Chalk of Dover.
- „ fig. 16. Another young specimen from the Norwich Chalk, belonging to Mr. Woodward.

Plate IV, figs. 17 and 19. Two specimens from the Chalk of Letheringsett, Norfolk, in the collection of Mr. C. B. Rose.

„ fig. 18. Another variety from Norwich, a shape similar to M. D'Orbigny's type of *T. Hebertiana*.

„ fig. 20. A specimen from the Chalk of Norwich, in the collection of Mr. Fitch.

„ fig. 20^c. An enlarged illustration; this is the shape on which Mr. Woodward established his *Ter. pentangulata*. Similar specimens exist in the collection of the Museum at Cambridge, and in that of the Rev. T. Image, &c.

„ fig. 26. The smallest specimen we have observed.

„ fig. 27. A young shell from the Chalk detritus of Charing (Kent), in the collection of Mr. Harris.

„ fig. 27^{ab}. An enlarged illustration.

„ fig. 28. A young shell from the Upper Chalk of Pewsey (Wilts), in the collection of Mr. Cunnington.

„ fig. 28^{ab}. Enlarged figures.

In many cases, I have given magnified illustrations of a small portion of the shell; these vary from different states of preservation, and from the spinose granulations being more or less separate; it will likewise be observed, that in most specimens a dark longitudinal line is seen to extend to a certain length along the smaller valve arising from the internal septum, but it is not visible on specimens in a fine state of preservation, and where the spinose granulation is perfect; it seems probable that this species, when alive, was slightly tinted with red, traces being discernible on many specimens in the Cambridge Museum. *K. lima* has also been found in the Chalk of Sussex, by Messrs. Dixon and Catt, and by myself in the Chalk Marl of Lewes. On the Continent, at Havre (Seine Inférieure), at Chavot and Césane, near Ay (Marne), &c.

Genus—TEREBRATULA, *Lhwyd*. 1698.

Animal fixed to submarine bodies by means of a pedicle issuing from a foramen in the beak of larger valve; edges of the mantle thin, entire, and fringed by short cilia, vascular system ramified, and situated on the mantle. Shell punctuated, variable in shape, inequivalve, elongated or transverse; convex or depressed, beak more or less produced, truncated by a foramen of variable dimensions, valves articulating by the means of two teeth in larger and corresponding sockets in smaller valve; internal ribband-shaped lamella (partly supporting the ciliated arms), attached only to the crura, short or elongated, and more or less folded back on itself.

Obs. Nearly all our Cretaceous Terebratulæ had a short loop. *T. longa*, of Rœmer, is an exception, in it the apophysary system extended to near the frontal margin, as in *Ter. lagenalis*, &c.

16. TEREBRATULA CAPILLATA, D'Archiac. Plate V, fig. 12^{a b c d}.

TEREBRATULA CAPILLATA, D'Archiac, 1846. Bull. de la Soc. Géologique de France, vol. iii, 2de ser., p. 336; and 1847, Mémoires de la Soc. Géol. de France, vol. ii, 2de ser., p. 323; pl. xx, figs. 1, 2, and 3.

— — Bronn. Index Pal., p. 1232, 1848.

Diagnosis. Shell irregularly oval, or somewhat pentangular, longer than wide; valves unequally convex, the dental or larger one the most so, no mesial fold or sinus; valves regularly convex to the front; margin line presenting a slightly elevated curve, or biplication in front; beak short, rounded and recurved, diagonally truncated by a large circular foramen, a portion of which is completed by a small deltidium in two pieces; beak ridges not always well defined, soon turning in to meet the hinge margin; surface ornamented by a vast number of minute radiating capilliform elevated striæ close together, unequal, and more or less undulating, these being intersected at variable distances by concentric lines of growth. Structure punctuated, interior unknown, but probably possessing a short loop. Length 13, width 11, depth 8 lines.

Obs. Among the different specimens sent for my inspection by Messrs. Fitch and Carter, from the Red Chalk of Hunstanton Cliff, Norfolk, I was agreeably surprised to find two perfectly characterised specimens of the *Terebratula capillata*, D'Archiac, one of the most characteristic fossils of the Tourtia of Belgium, the small narrow capilliform waving striæ being perfectly preserved on our specimens, and distinguishes them from the other species peculiar to the Cretaceous period. I am surprised to find, in p. 172 of M. D'Orbigny's 'Prodrome,' that author does not perceive the marked differences between this and *Ter. depressa* of Lamarck, to which last he refers the present form, stating these differences to be only due to age and superficial wearing; this is, however, far from being the case; the very shape in both is quite distinct; the elongated beak and deltidium of *T. depressa* alone would distinguish it from *T. capillata*; and from an extensive and well-preserved series of both forms collected by myself in Belgium, I feel no doubt that at all ages *T. depressa* was smooth, while *T. capillata* is ornamented as described above. *T. capillata* has been well described, and beautifully illustrated, by Viscount D'Archiac, and is not very rare at Tournay, in Belgium.

Plate V, fig. 12^{a b c}. Specimen from the Red Chalk of Hunstanton Cliff, Norfolk, in the collection of Mr. Fitch, of Norwich. A similar one is preserved in the collection of Mr. Carter, of Cambridge.

„ figs. 12' and 12. Enlarged illustrations.

17. *TEREBRATULA OVATA*, *Sowerby*. Plate IV, figs. 6—13.

TEREBRATULA OVATA, *Sow.* Min. Con., vol. i, p. 46, tab. xv, fig. iii, 1812.

— — *Parkinson*. An Int. to the Study of Org. Remains, 1822.

— — *Fleming*. A History of British An., vol. i, 1828.

— — *Woodward*. Synop. Table of Br. Org. Rem., p. 21, 1830.

— — *Brown*. Ill. of Foss. Conch. of Gr. Br., pl. lv, figs. 34, 35, 1838.

— — *Morris*. Catalogue of British Fossils, 1843.

— — *Tennant*. A Strat. List of British Fossils, p. 47, 1847.

— *LACRYMOSA*, *D'Orb.* Pal. Franç. Ter. Crét., vol. iv, p. 99, pl. 512, figs. 6—11, 1847; and Prodrôme, vol. ii, p. 172, 1850.

— *CARNEA*, *Bronn*. Index Pal., p. 1232, 1848. (Non *T. carnea*, *Sow.*)

Diagnosis. Shell ovate, or oblong-ovate, depressed; beak produced, recurved, obliquely truncated by a rather large circular foramen, partly formed out of the substance of the beak, and completed by two small deltidial plates; beak ridges well defined, leaving a slightly concave false area between them and the hinge margin. Valves unequally convex, the smaller or imperforated one is less so than the other; uninterruptedly convex to the margin in the young state, but soon assuming a longitudinal depression, appearing at about the middle of the valve, extending and becoming deeper as it approaches the front. In the larger valve, a corresponding longitudinal elevation or keel occurs; marginal line wavy, and in front indented by the smaller valve. Surface covered by irregular elongated longitudinal elevated rugæ, little interrupted in the middle of the valves, but on the sides diverge and form innumerable small oblong tubercles, sometimes extending above the surface of the shell in the form of short spines. Concentric lines of growth numerous; structure distinctly punctuated, interior unknown; dimensions variable, the largest example yet found measuring, length 19, width 13, depth 11 lines; but the greater number of specimens do not attain these dimensions.

Obs. This is one of *Sowerby*'s first-described species, which he obtained at "Chute, near Heytesbury, in Wiltshire." The species is perfectly known in England, and one of the most abundant of the tribe found in the Upper Green Sand of the locality above named, and discovered likewise by Messrs. Moore and Morris in the Chloritic Chalk of Chard and Chardstock; these specimens, however, rarely preserve the remarkable structure which characterises the species, from the nature of the sediment in which they were deposited having deteriorated the surface of most of them; this character was not observed by *Sowerby*; but, as the species is very common, it is not very difficult to procure specimens preserving their structure; and some, in the collections of Messrs. Cunningham, Moore, and Morris, show it to perfection. Many authors on the continent, among others Professor *Bronn*, have erroneously believed it a synonym of *Ter. Carnea*,¹ that species not having been

¹ Dr. Mantell, in his 'Geol. of the South Downs,' p. 209, 1822, erroneously places *T. ovata*, *Sow.*, in the Upper and Lower Chalk, where the *Sowerby* type has never been as yet found. It is probable that this error is the cause of foreign authors believing *T. ovata*, *Sow.*, to be a synonym of *Carnea*.

yet discovered in the Upper Green Sand; others, such as Nilsson,¹ Hisinger,² and Røemer,³ refer to Sowerby's species quite another shell from the Chalk, all three referring to the same figure of Nilsson. M. D'Orbigny admits, in his 'Pal. Tran.,' pp. 103-4, that those authors are mistaken, and places their *T. ovata* as a synonym of *T. Carnea*, but M. D'Orbigny figures and describes in page 99, under the new name of *Terebratula lacrymosa*, Sowerby's *Ter. ovata*, with which he was unacquainted. We regret being obliged to deprive that author of his supposed new form; but, as Sowerby's shell was figured and described in 1812, and as it is well known, we cannot give priority to that by M. D'Orbigny published in 1847.

More than two hundred specimens of this type have been minutely examined by myself from the dimensions of 2 to 19 lines; in young, and even in some more advanced ages, there are no traces of the longitudinal depression, sometimes so very deep in adult shells, as may be remarked in figs. 11 and 12, Pl. IV; the first appearance in the young is a slight depression, only quite near the margin.

Sometimes, as may be remarked in fig. 9 of the same Plate, up to a certain age, the valves were regularly convex, when a sudden stoppage in the growth occurred; and, on its being resumed, they at once presented a strongly marked depression extending to the front; this species is generally much depressed, but in some exceptional cases assumes great convexity, the width and depth being about the same as in fig. 12; but, as will be observed, the characters of the form are there as well preserved as on figs. 10 and 11, which may be taken as good types of the species. Sowerby's figure unfortunately does not exhibit this depression, and more resembles fig. 8. We regret not having been able to study the interior, our attempts having failed from the nature of the matrix; but we are disposed to believe, that the calcareous appendages were not arranged as in true *Terebratula*, perhaps more like what we find in *Kingena lima*; the external structure being somewhat similar, leads me to imagine them closely related; but, as it is of no use shifting species until we are certain of their true place, we will allow *T. ovata* to remain for the present in the genus *Terebratula*.

T. ovata has been discovered by M. D'Orbigny in the Lowest Green or Chloritic beds of Cap la Hève, near Havre; this bed and locality contains the same species we find at Chute, near Warminster.

Plate IV, fig. 6. A very young shell, from near Warminster.

„ fig. 7, 8. Two specimens from the Chloritic Marl of Chardstock, in the collection of Mr. Morris.

„ fig. 9. A specimen, showing a sudden stoppage of growth, &c., from the Chloritic Chalk of Chard, in the collection of Mr. Moore.

¹ 'Petrefacta Succana,' 1827, pl. iv, fig. 3.

² 'Leth. Succ.' 1837, pl. xxiv, fig. 3.

³ 'Die Vers. Nord.,' 1840, p. 43.

Plate IV, fig. 10. Another more adult shell from the same bed and locality, also from the collection of Mr. Moore.

„ fig. 11. A very adult specimen from the Upper Green Sand, near Warminster, in the collection of Mr. Cunningham.

„ figs. 12, 13. Two exceptional shapes, likewise from the same locality and collection.

18. *TEREBRATULA RUGULOSA*, *Morris*. Plate IV, figs. 14, 14^a.

TEREBRATULA RUGULOSA, *Morris*. *Annals and Mag. of Nat. Hist.*, vol. xx. p. 253, pl. xviii, figs. 5, 5^a, 1847.

— *DISPARIALIS* (pars), *D'Orb.* *Pal. Franc. Ter. Cret.*, vol iv, p. 100, pl. 512, figs. 12, 13, (but not figs. 16, 17, which belong to *T. squamosa* of Mantell,) 1847.

Diagnosis. Shell ovate or somewhat irregularly pentagonal, longer than wide, straight or slightly indented in front; valves almost equally convex, dental one most so; a small depression existing near the front in some specimens, the margin of smaller valve slightly underlying the perforated one; beak rather produced, not much recurved, obliquely truncated by a large circular foramen; deltidium small, in two pieces, partly surrounding the foramen; beak ridges moderately distinct. Surface covered by minute rugæ, and in general the middle portion of each valve longitudinally, and but little interrupted. Those on the side diverge and have a tendency to break into small oblong tubercles, slightly projecting sometimes in the form of short spines. Structure distinctly and thickly punctuated. Interior unknown; dimensions variable; length 11, width 8, depth 7 lines.

Obs. This form was described and figured by Mr. Morris and myself, in 1847, under the name of *T. rugulosa*; a little later it received from M. D'Orbigny that of *T. disparialis*, but the last-named author includes in his species another form which we consider distinct and known in England under the name of *T. squamosa* (Mantell,) the surface being ornamented by wavy striæ and numerous squamose concentric lines of growth. Both *Ter. rugulosa* and *squamosa* occur in great numbers in the Chloritic Chalk of Rouen, and seem to me always easily distinguished: in England they are equally distinct, and separable from *T. ovata*, the last being much more convex, and deprived of that remarkable longitudinal depression in the smaller valve, and the corresponding keel-shaped projection in the larger one; in *T. rugulosa* the convexity extending in most cases regularly to the front, where sometimes a wide but slender depression is seen, quite different from that observable in *T. ovata*, and confined to the margin; by its exterior ornaments it approaches, however, to *Ter. ovata*, as justly observed by M. D'Orbigny, but the general aspect of the shell is otherwise quite different. Both species may, therefore, for the present, be conveniently retained under distinct appellations; the irregular manner in which the tubercles are disposed is very remarkable; some are shorter and wider than others, arising at different

levels, and often, though close at their origin, diverge while others converge, so that notwithstanding that the greater number follow the same direction, they are not individually parallel to each other. We regret not having been able to examine the interior of this form, which we suppose different from that of true *Terebratula*, but with which it had better remain till further investigation.

T. rugulosa has been found in England by Messrs. Moore, Bunbury, and Pratt, in the Chalk with green grains at Chard Chadstock and Chaldon along with *T. ovata*. In France I have found it in great numbers at Rouen, in beds of the same age.

Plate IV, fig. 14. A specimen, natural size, from the collection of Mr. Moore.

„ fig. 14^d. Another specimen, enlarged, in my collection.

19. *TEREBRATULA SQUAMOSA*, *Mantell*. Plate V, figs. 5—11.

TEREBRATULA SQUAMOSA, *Mantell*. Geol. of Sussex, p. 132, 1822.

— — *Morris and Dav.* Annals and Mag. of Nat. Hist., vol. xx, p. 254, pl. xviii, fig. 8^{a b}, 1847.

DISPARIALIS (pars), *D'Orb.* Pal. Franç. Ter. Crétacées, vol. iv, p. 100, pl. 512, figs. 16, 17, (not figs. 12, 13, which belong to *T. rugulosa*,) 1847.

SQUAMOSA, *Bronn*. Index Pal., p. 1251, 1848.

Diagnosis. Shell orbicular, or somewhat longitudinally ovate, valves nearly equally convex, sometimes gibbous; beak moderately produced and obliquely truncated by a circular entire foramen; deltidium small, rather dilated at the base, the convexity of the valves is at times equal to the front, while in other specimens there exists in the anterior portion of the imperforated valve a longitudinal depression and tendency to biplication. Surface marked with concentric squamose ridges, crossed by numerous radiating zig-zag raised striæ, giving to the squamæ an irregular serrated appearance; structure punctuated, punctæ rather widely separated; interior unknown. Dimensions variable, the largest specimen as yet discovered measuring, length 15, width 12, depth 9 lines, but the average size is, length 7, width 6, depth $5\frac{1}{2}$ lines.

Obs. This species was described in 1822 by Dr. Mantell, who found it in the Gray Marl, of Hornsey. It is a form well known in England, but not having been illustrated by that celebrated geologist, Mr. Morris and myself thought it advisable to re-describe and figure the species in the 'Annals,' 1847; about this period or later M. D'Orbigny published the same shell under the name of *T. disparialis*, associating with it another form which we separate. Since that period the discovery of a great many British specimens in different localities allow us to notice several of its most important variations, and which are illustrated in Plate V. Dr. Mantell was provided only with small and young specimens, fig. 5 of our Plate; but Mr. Cunningham discovered at Pottern Butts, in the Upper Green Sand, specimens attaining much larger dimensions, as may be seen by figs. 8 and 9. In a few adult individuals there exists a tendency to biplication; a character which to that extent

must be considered exceptional. It has likewise been lately discovered by Messrs. Moore and Morris in the Chalk with green grains or Chloritic Marl, of Chard, Chaldon, and Evershot; also in the Gray Chalk between Dover and Folkstone by Messrs. Mackey, Morris, and myself. Its vertical range is, therefore, from the Upper Green Sand to the Gray Chalk. I regret not having been able to examine the interior of this species, and suspect its organisation will prove to be distinct from that of true *Terebratula*, where however we must leave it for the present. *T. squamosa* is very common in the *Craie Chloritée* of Rouen, where it has been collected by M. D'Orbigny and myself.

Plate V, fig. 5. The original specimen on which Dr. Mantell founded his species from the Chalk Marl of Hornsey, in the collection of the British Museum.

„ fig. 6. 6^{ab} . A specimen, natural size, from the Gray Chalk between Folkstone and Dover, in the collection of Mr. Morris.

„ 6^d . The same, enlarged.

„ 6^c . A fragment of the same, likewise considerably magnified.

„ fig. 5A. Another specimen, from the same locality, in the collection of Mr. Mackey.

„ figs. 7, 8, 9, 10. Specimens, natural size, from the Upper Green Sand of Pottern Butts, in the collection of Mr. Cunningham.

„ fig. 11. A specimen from the Chloritic Marl of Chard, in the collection of Mr. Moore.

„ fig. 11 abcd . Enlarged illustrations of the same.

20. TEREBRATULA OBLONGA, Sow. Plate II, figs. 29—32.

TEREBRATULA OBLONGA, *Sowerby*. Min. Conch., vol. vi, p. 68, tab. 535, figs. 4, 5, 6, 1829.

— OBLONGA, *V. Buch.* Uber Ter., 1834, and Mém. Soc. Geol. de France, vol. iii, p. 359, pl. xvi, fig. 2, 1838.

— — *Ræmer*. Kreid., p. 39, No. 18, 1840.

— QUADRATA, *Fitton*. Trans. Geol. Soc., vol. iv, pl. xiv, fig. 9, 1836.

— OBLONGA, *Morris*. Catalogue, 1843.

— — *Forbes*. Quart. Journal of the Geol. Soc., vol. i, p. 346, No. 106, (non 105, as erroneously stated by M. D'Orbigny,) 1845.

TEREBRATELLA — *D'Orb.* Pal. Française Ter. Cretacées, vol. iv, p. 113, pl. 515, figs. 7—19, 1847.

TEREBRATULA — *Cunnington*. Quart. Journal of the Geol. Soc., vol. vi, p. 454, 1850.

TEREBRATELLA — *D'Orb.* Prodrome, vol. ii, p. 85, 1850.

Diagnosis. Shell oval, oblong, gibbous; beak nearly straight, rather produced; foramen entire, formed out of a portion of the truncated beak and the two deltidial plates

which it indents, and is more or less separated from the umbo ; beak ridges well defined, leaving between them and the hinge margin a flat, false area ; the marginal line nearly straight all round ; valves nearly equally convex ; surface ornamented by a variable number of plaits, either simple or bifurcated, at irregular distances from the beaks and umbo. Structure punctuated ; length 12, width 9, depth 7 lines.

Obs. When young, the shells of this species present less convexity than at a more advanced age, they are also very variable in the form and number of their plaits ; in some specimens, and more especially in the young, the costæ are all simple from the beak and umbo to the margin, one or two only bifurcating on the sides ; but in the generality of specimens, the bifurcation and intercalation of plaits at various distances from the beak and umbo is very remarkable, particularly in some French shells, these bifurcate several times before reaching the margin, presenting longitudinal undulations ; the number therefore of the plaits is very variable ; we have specimens with from twenty to thirty on each valve ; others with from thirty to forty-six ; sixteen to eighteen of which are due to bifurcation and intercalation within the anterior third of the length of the valves. This species is quite distinct from *Ter. cardium*, Lamarck ; although mistaken by some authors, as Professor Bronn,¹ who believed it a simple synonym of the Lamarckian type. *T. oblonga* is a much more oblong and oval shell ; the beak is more produced ; the foramen completely different, being widely separated from the umbo, while in *T. cardium* it lies almost contiguous to it, and the plaits are fewer in number, generally only bifurcating in the young, while in the Cretaceous species this character is prevalent in all ages, and especially in the advanced state ; I do not agree, therefore, with Mr. Austen,² when he states that this species is common both to the Oolitic and Cretaceous Formations ; at least after a minute examination of a multitude of Foreign and British specimens of both, I have not come to that conclusion.

I am not quite certain as to the *genus* to which this species belongs, from not having been able to see the interior. M. D'Orbigny places it in his *Terebratella*, to which it may, perhaps, belong ; but as he does not state it to have a doubly attached loop, I will leave it for the present among the *Terebratulæ*. *T. quadrata*, Sow., is only an exceptional variety of this species. *T. oblonga* is found in England, in the Lower Green Sand of Atherfield, Hythe, near Devizes, Maidstone, and Farringdon, whence it has been collected by Messrs. Walton, Harris, Morris, myself, and others ; it has likewise been found in the Upper Green Sand of the neighbourhood of Warminster, by Mr. Cunningham, but the species is very rare in that locality. In France, it occurs at Wassy, St. Dizier, &c., and is well described and figured by M. D'Orbigny, in his 'Pal. Française ;' in Switzerland, it is mentioned from Neufchâtel, and from several German localities, such as in the neighbourhood of Brunswick in the Hilsconglomerat of Essen, Schandelahe, Schoppenstedt, &c.

¹ Index Pal., p. 1243.

² 'On the Lower Green Sand of Farringdon, &c.,' Quart. Journal of the Geol. Society, vol. iv, p. 477, 1850.

- Plate II, figs. 29, 29^a. A specimen from the Lower Green Sand of Hythe.
 „ figs. 30, 30^{a b c d}. From the Lower Green Sand of the same locality, in the collection of Mr. Morris.
 „ figs. 31, 31^{a b}. From the Green Sand of Farringdon, in the collection of Mr. Cunningham.
 „ figs. 32, 32^{a b}. From the Upper Green Sand of Warminster, in the collection of Mr. Cunningham.

21. *TEREBRATULA OBESA*, Sow. Plate V, figs. 13—16.

TEREBRATULA OBESA, Sow. Min. Con., vol. v, p. 54, tab. 438, fig. 1, 1825.

- | | | |
|---|---|---|
| — | — | <i>Fleming</i> . A Hist. of Brit. An., p. 371, 1828. |
| — | — | <i>Brown</i> . Illust. of Foss. Conch., p. 133, pl. liv, figs. 28, 29, 1836. |
| — | — | ? <i>Rœmer</i> . Die Vers. Nord. Kreid., p. 43, 1840. |
| — | — | <i>Morris</i> . Catalogue, p. 134, 1843. |
| — | — | <i>Tennant</i> . A Strat. list of Brit. Foss., p. 47, 1847. |
| — | — | <i>D'Orbigny</i> . Pal. Franç. Ter. Cretacées, vol. iv, p. 101, pl. 513, figs. 1—4, 1847. |

Diagnosis. Shell irregularly ovate, oblong, very convex, straight or slightly indented in front; beak short, incurved, truncated by a large circular foramen lying close to the umbo, so that the deltidium is rarely exposed; beak ridges indistinct; margin line wavy; imperforated valve less convex than the dental one, presenting a very gentle longitudinal curve from the beak to the front; the central portion of the valve is nearly flat, with a slight longitudinal depression towards the front, giving rise to two lateral obtuse plaits; larger valve almost uninterruptedly convex; front elevated; surface smooth, marked with concentric lines of growth; structure punctuated; loop short, wide, anneliform, and confined to the posterior portion of the shell, not exceeding a third of the length of the valve; simply attached to the crural base, the two riband-shaped lamellæ are soon united by a transverse lamella bent upwards in the middle; dimensions variable; the largest specimen known measures length $2\frac{1}{2}$ inches, width 2 inches, depth $1\frac{1}{2}$ inch.

Obs. This is our largest British Cretaceous Brachiopoda, described in 1825 by Sowerby, under the name of *T. obesa*, and cannot be said to be common; indeed we believe it so closely allied to *Ter. Dutempliana*,¹ (D'Orb.), by all its most important characters, that it may probably be only the giants of that form, and I have no doubt that all the passages linking them together may be easily obtained; but Palæontologists seem anxious to retain both names, the present one for those very convex shells illustrated in our Plate V; we place them, therefore, under distinct heads while retaining our opinion as above. One of the most marked characters of this species is its large and edged foramen, which

¹ *T. Dutempliana* is a shell known under the name of *Ter. biplicata*, Sow., but that name had been given to another species by Brocchi in 1814.

distinguishes it from *T. semiglobosa*, and I therefore cannot agree with Professors Bronn,¹ Reuss,² and V. Buch,³ who place it as a synonym of that species. M. D'Orbigny considers *T. Albensis*⁴ a synonym of *Obesa*, but I am more inclined to place it as a variety of *Semiglobosa*. *T. sulcifera*, Morris,⁵ in my opinion more closely approaches *T. obesa* than any of the others mentioned, but from the remarkable, regular, and peculiar concentric lines of growth ornamenting its surface it may be conveniently retained under a distinct appellation. The largest specimen of *T. obesa*, yet discovered, is from the Upper Green Sand; but almost as large a shell has likewise been obtained from the Chalk in the neighbourhood of Norwich. Sowerby states his specimens to be from the Chalk at Norton Bevant, near Warminster. In France it is rare at Rouen, and indeed everywhere, although common in the state of *T. Dutempliana*, which seems to confirm my views above mentioned. On the sides of the valve may be remarked small raised striæ; this is also observable on *T. Dutempliana*.

Plate V, fig. 13, 14. The two largest known specimens, from the Chalk of Norwich, in the collection of Mr. Fitch.

„ fig. 15. A specimen from the same locality, in my collection, much resembling Sowerby's figure in the 'Min. Conch.'

„ fig. 16. The largest specimen yet discovered of this species, from the Upper Green Sand, near Warminster, in the collection of Mr. Cunningham.

¹ Index Pal., p. 1250, Prof. Bronn mentions as synonyms of *T. semiglobosa*, *T. subundata*, *undata*, *obesa*, and *albensis*, none of which we believe correctly placed with *T. obesa*.

² Die Vers. der Bohem. Kreid., 1846, p. 51. The following are the synonyms here given of *T. semiglobosa*, *T. intermedia*, (a cornbrash shell,) *T. albensis*, *T. subundata*, *T. obesa*, *T. acuta*, none of Reuss' figures resemble Sowerby's *T. obesa*.

³ Über Ter. and Mém. de la Soc. Géol. de France, vol. iii, p. 225. V. Buch's synonyms are still more defective; he considers *T. globata*, Sow., an inferior oolite shell, and *T. Sphæroidalis*, likewise from the same strata, as synonyms of *T. obesa*, this last with a point of interrogation.

⁴ Leymerie Mém. de la Soc. Géol. de France, vol. xv, p. 11, pl. v, figs. 1—3.

⁵ Morris and Dav. 'Ann. and Mag. of Nat. Hist.,' vol. xx, p. 254, pl. xviii, figs. 7, 7*. 1847.

PLATE I.

CRETACEOUS SPECIES.

Fig.		
1, 2 ^a .	<i>Crania Parisiensis</i> .	Interior of attached valve, enlarged.
2 ^b .	„ „	„ of upper valve „
3.	„ „	A portion of the Interior of attached valve, much enlarged.
4, 5, 6.	„ „	Exterior of both valves.
7.	„ „	A group of <i>Cranias</i> (from Meudon).
8.	<i>Crania Egnabergensis</i> ,	natural size : exterior of upper valve.
8 ^a .	„ „	Interior of attached valve, enlarged.
8 ^b .	„ „	Interior of upper valve „
8 ^c .	„ „	Exterior of attached valve : this specimen was only fixed by a small portion of the vertex ; enlarged.
8 ^d .	„ „	A profile view of both valves, united and attached to a slender coral.
9.	„ „	Exterior of attached valve, enlarged, showing the coral to which it was fixed.
10, 11.	„ „	Young specimens, with few costæ.
12.	„ „	(<i>Crania ovalis</i> of Woodward), a malformation.
13, 13 ^{a b} .	„ „	A specimen, fixed by a considerable portion of its lower valve to a shell.
14.	„ „	Shows the valve not fixed by the whole surface, as in <i>C. Parisiensis</i> , figs. 5, 6, 7.
15.	<i>Thecidea Wetherellii</i> ,	nat. size, fixed by nearly all the surface of the attached valve to an <i>echinus</i> .
16.	„ „	Interior of the smaller valve, enlarged.
17.	„ „	„ larger valve „
18.	„ „	Exterior, enlarged illustration.
19.	„ „	Profile view, enlarged.
20 to 26.	„ „	From the Chalk of Pewsey (Wilts). These different enlarged illustrations show the variable manner in which this species was fixed.
27.	<i>Lingula truncata</i> ,	nat. size.
28.	„ „	Profile view.
31.	„ „	As figured by Dr. Fitton, from Hythe.
29, 30.	„ subovalis,	nat. size.
29 ^a .	„ „	Interior enlarged.

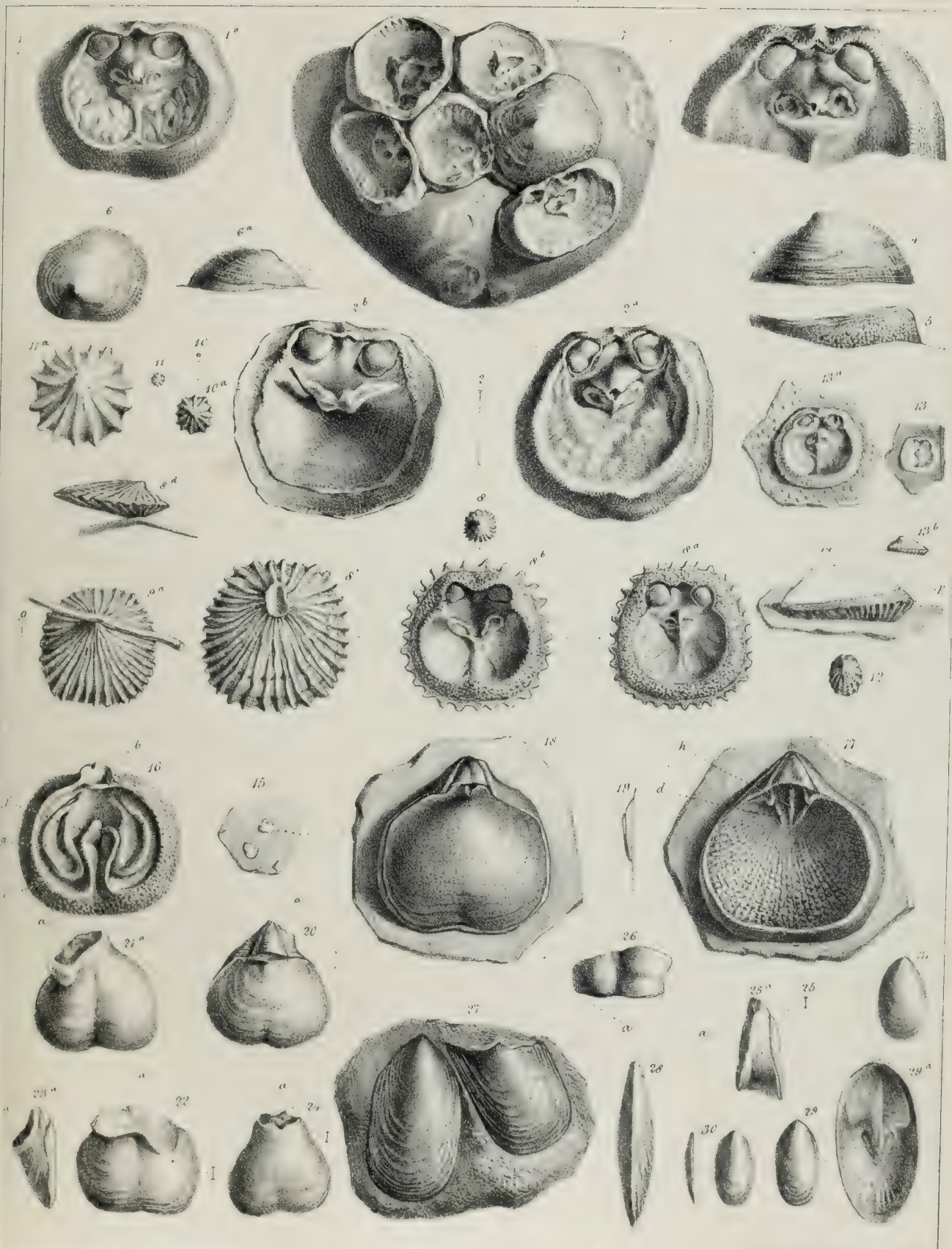


PLATE II.

CRETACEOUS SPECIES.

Fig.			
1 to 12 and 33.	<i>Magas pumilus.</i>	A series of passages and varieties—enlarged: figs. 2, 4, and 5, resemble Sowerby's type.	
12 ^a .	„ „	Interior of larger or dental valve.	
12 ^b .	„ „	„ smaller valve, enlarged.	
12 ^c .	„ „	Profile of the interior of both valves.	
13, 14, 16, 17.	<i>Terebratulina gracilis.</i>	Different specimens and varieties, enlarged.	
15.	„ „	Interior of smaller valve, enlarged.	
18 to 28.	„ <i>striata.</i>	Various forms, varieties, and ages, from different deposits, enlarged.	
19 ^a .	„ „	Interior of smaller valve, enlarged.	
29 to 32.	<i>Terebratula oblonga.</i>	Various specimens and varieties, enlarged.	



PLATE III.

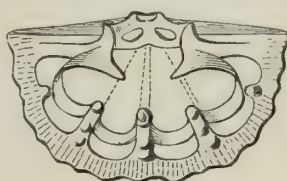
CRETACEOUS SPECIES.

Fig.

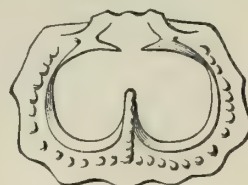
- 1 to 13. *Argiope decemcostata*, various specimens, illustrating a few varieties of this form.¹
6. " " Interior of smaller valve, enlarged.
7. " " " larger valve, "
- 14, 15. *Argiope decollata*, (recent,) placed here merely to show that the internal arrangements are more simple in the fossil form. See the woodcut, Part I, page 9.²
- 17 to 28. *Terebrirostra lyra*, a number of specimens, nat. size.
27. " " a portion of the interior of smaller valve, the loop is not known; $\frac{1}{2}$ shows the produced boss.
- 25 and 28. " " Sections of the beak, enlarged.
29. *Terebratella pectita*, the largest British specimen, nat. size.
- 30 to 33. " " different varieties, enlarged.
- 34 to 42. " *Menardi*, various specimens and varieties, mostly enlarged.
- 34 to 47. " " nat. size.
- 40^a. " " Interior of large valve, enlarged.
41. " " " smaller valve, "
42. " " A French specimen from Mans, enlarged, placed here for the sake of comparisons.

¹ Since the description of our British Cretaceous *Argiope* had gone through the press, I received from Mr. Suess, of Vienna, a most interesting communication on *Argiope* (*Ter.*) *decemcostata* of Rœmer, in which that accurate observer had discovered the existence of a loop like that of *Argiope cistellula*, &c. However, none of my French, Belgian, or English specimens belonging to the form I figure, and attributed by myself to *A. decemcostata*, preserve the loop, or exhibit the mesial septum to the extent represented by Mr. Suess. It may be doubted whether these differences between my specimens and that of Mr. Suess are specific, or only due to age and state of preservation.

² Prof. Forbes and Mr. Cuming having kindly given me specimens of the other three recent species of *Argiope*, I am able to add some details respecting them, which are necessary for the illustration of the genus.



Argiope decollata.



Argiope Neapolitana.

- I. *Argiope cuneata* (Risso), erroneously mentioned by me as a synonym with *A. decollata*, has only a single median septum; the lobes of the loop are free for one half their extent in the specimen examined, and blend with the shell, as we have noticed in some examples of *A. decollata*.
- II. *Argiope Neapolitana* (Scacchi), *T. seminulum*, Phil. In this form the same longitudinal septum exists, but the loop was imperfect in the specimens at my disposal.
- III. *Argiope cistellula* (J. Wood). In this species the same mesial septum coexists with a complete two-lobed loop, as represented in *A. Neapolitana*. The animal is preserved, and differs only from the figure given at Part I, in having two lobes instead of four. In justice to M. Philippi, I must state that his figure of the animal of *A. decollata* is essentially correct; but it is so small, that it has been overlooked or misunderstood by all succeeding writers. M. Philippi himself failed to discover the loop, and perceive the nature of the fringed arms which he described and figured.

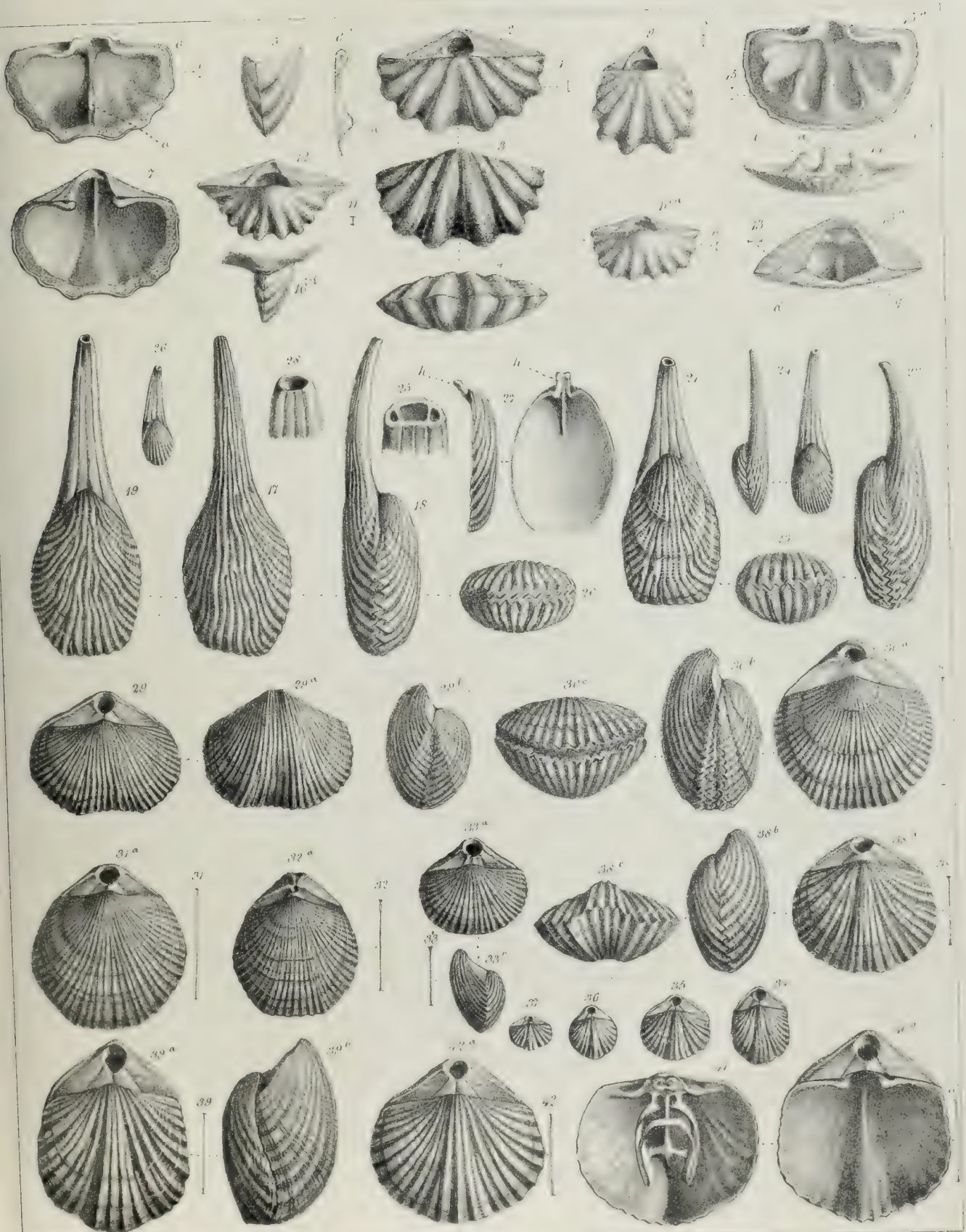


PLATE IV.

CRETACEOUS SPECIES.

- | | | | |
|----------------------|---|--------------------------|--|
| Fig. | | | |
| 1. | | Trigonosemus elegans, | the largest specimen yet discovered in England. |
| 1 ^{c d} . | „ | „ | Enlarged illustration. |
| 2. | „ | „ | Another specimen, nat. size. |
| 2 ^b . | „ | „ | The same, enlarged. |
| 3. | „ | „ | Nat. size. |
| 3 ^{a b c} . | „ | „ | Enlarged. |
| 4. | „ | „ | Interior of smaller valve, enlarged. |
| 4 ^a . | „ | „ | Profile view of the same. |
| 4 ^b . | „ | „ | Interior of larger valve. |
| 5. | „ | incerta, | nat. size. |
| 5 ^{a b c} . | „ | „ | Enlarged. |
| 6 to 13. | | Terebratula ovata, Sow., | a variety of specimens of different shapes and ages, |
| | | | nat. size. |
| 14. | „ | rugulosa, | nat. size. |
| 14 ^d . | „ | „ | Enlarged. |
| 15 to 28. | | Kingena lima, | a series of specimens and variations. |
| 22. | „ | „ | nat. size, and the largest specimen yet observed. |
| 24. | „ | „ | is the var. described under the name of <i>T. spinulosa</i> , the original specimen. |
| 25. | „ | „ | Interior of smaller valve, seen rather in front. |

CRETACEOUS

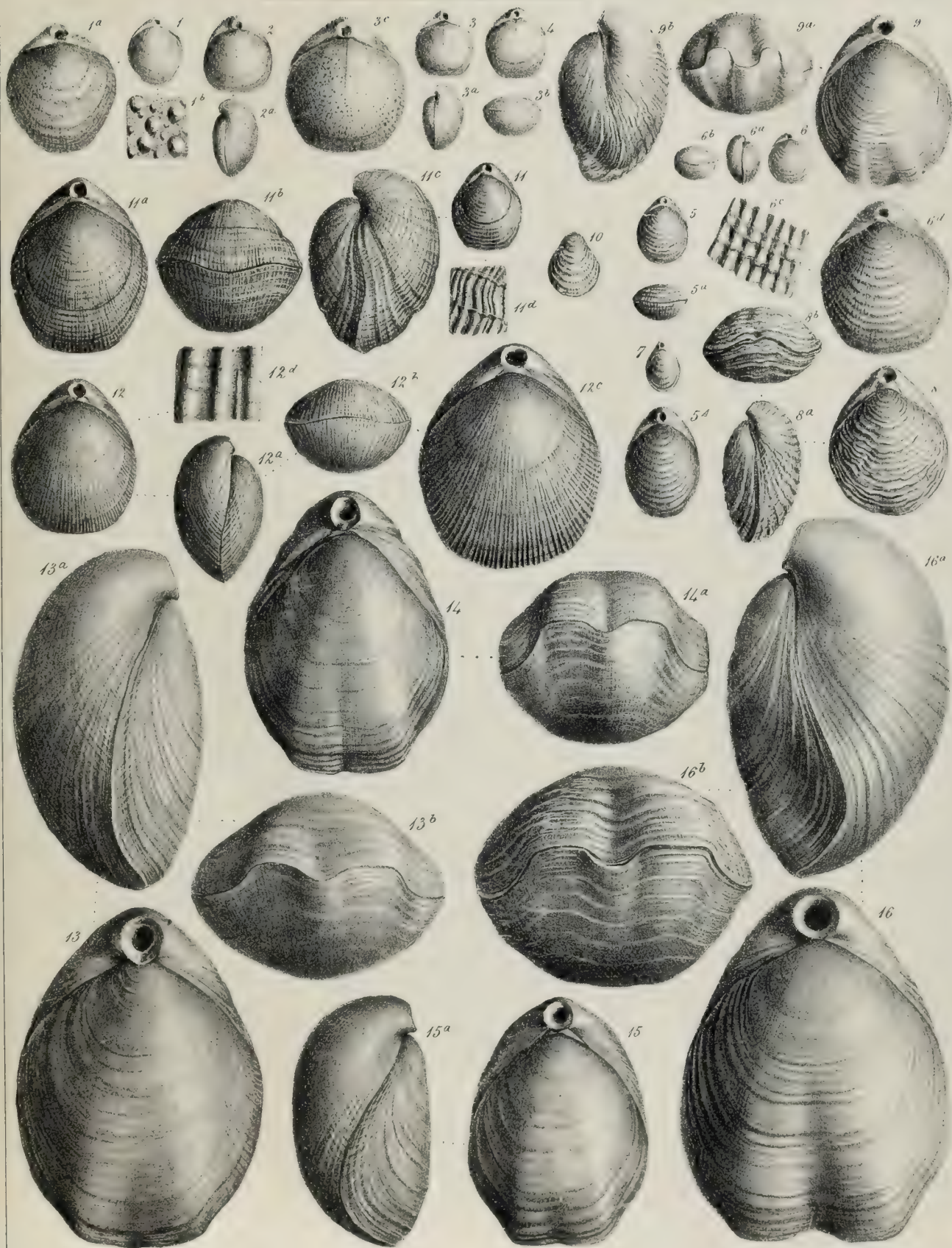


PLATE V.

CRETACEOUS SPECIES.

Fig.

- 1 to 4. *Kingena lima*, some more varieties.
5. *Terebratula squamosa*, nat. size. Dr. Mantell's original specimen.
6 to 11. „ „ several varieties from different localities.
12. „ *capillata*, nat. size.
12^c. „ „ enlarged figure.
13 to 16. „ *obesa*, nat. size, the largest specimens known.



THE
PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

LONDON:

MDCCCLII.

A MONOGRAPH
OF
BRITISH
OOLITIC AND LIASIC BRACHIOPODA.

BY
THOMAS DAVIDSON,
MEMBER OF THE GEOLOGICAL SOCIETY OF FRANCE.

PART III.
CONCLUSION.

LONDON :
PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

1852.

C. AND J. ADLARD, PRINTERS, BARTHOLOMEW CLOSE.

Genus—RHYNCHONELLA, *Fischer*. 1809.

Animal small, generally attached to submarine objects by means of a pedicle issuing from the foramen placed under the beak of the larger valve. Shell inequivalve, variable in shape, wider than long, or longer than wide, circular or elongated; valves more or less convex, with or without a longitudinal mesial fold and sinus; beak acute, slightly or greatly recurved; no true area; foramen variable in its dimensions and form, placed under the beak, exposed or concealed, entirely or partially surrounded by a deltidium in two pieces, at times extending in the shape of a tubular expansion, at other times rudimentary; the foramen being completed by a small portion of the umbo. Surface striated, plaited, or costellated, rarely smooth; structure fibrous, unpunctuated, rarely spiny; valves articulating by means of two teeth in the larger and corresponding sockets in the imperforated valve; apophysary system in smaller valves composed of two short, flattened, and grooved lamellæ, separate, and moderately curved upwards, attached to the inner side of the beak of smaller valve, and to which were affixed the free spiral fleshy arms;¹ a small central longitudinal septum, more or less elevated, is seen to extend along the bottom of the smaller valve from under the beak to about half or two thirds the length of the shell, and separating the muscular impressions visible on either side.

Obs. In Part I, I have mentioned the reasons for not admitting M. D'Orbigny's genus *Hemithiris*, established on *Rynchonella psittacea*, *Wilsoni*, &c., from a conviction, that these shells correspond in all essential characters to the genus *Rhynchonella*; internally their organisation is similar, the muscular impression and short calcareous process for the support of the free fleshy arms being the same in these as well as in all the species of this extensive genus, whether Recent, Cretaceous, Oolitic, or Palæozoic.² The external shape and character of the different species is, on the contrary, so variable and perplexing, that in many cases it seems almost impossible to trace a line of demarcation between

¹ See Professor Owen's 'Anatomy of *T. psittacea*,' Trans. of the Zool. Soc., vol. i, 2d part.

² Within the last few years, authors seem to agree, as to the propriety of adopting a separate genus for those plaited Terebratulæ, the calcareous appendages of which are formed of only two small, short, curved lamella, to which are attached the free, fleshy arms, as in *T. psittacea*, *loxia*, *vespertilis*, *octoplicata*, &c.

M. D'Orbigny, in 1847, admitted Fischer de Waldheim's genus *Rhynchonella*, giving the date 1825, and therefore unacquainted with a prior paper by that author, entitled 'Notice sur les Fossiles du Gouvernement de Moscou servant de Programme pour inviter les Membres de la Soc. Imperiale à la Séance publique du 26 Oct., Moscou, 1809,' wherein will be found the first descriptions and figures of the genus *Rhynchonella*.

Professor King, in Part III, of his valuable and interesting 'Monograph of the Permian Fossils,' states, "Reverting for a moment to the types named by the celebrated oryctographer of Moscow, I would ask, is anything satisfactorily known respecting *Trigonella atoma*? and *Rhynchonella loxia*? Has any one been able to identify these shells? What formation do they belong to? And what are their localities, &c.?" Most of those questions may be answered; but as the paper above alluded to (1809) is little known

them, or to draw up a description answering to all the variations, which are, doubtless, due to local and other accidental circumstances: we often find specimens of the same species very convex and gibbous, while others are comparatively depressed; the number of the plaits is also most variable, some shells being ornamented by a greater or less number; 1, 2, 3, 4, 5, 6, &c., forming in different examples of the same species, a more or less defined or elevated mesial fold. The beak is likewise in some nearly straight, exhibiting under it the foramen entirely or otherwise surrounded by the deltidium, while in other specimens no trace of the foramen and deltidium is visible, from the beak becoming so incurved, as almost to touch and overlie the umbo. The dimensions and form of the false area situated between the beak ridges and the hinge margin is also variable, and indents to a less or greater degree the hinge of the smaller valve. It is, therefore, only by combining certain general characters that we can separate certain forms of *Rhynchonella*, and it is very unsafe to establish new species on the simple inspection of one or two specimens, unless these present characters so marked and peculiar as to make confusion impossible. Many hundreds, I may say thousands, of British and Foreign *Rhynchonellæ* have passed under my examination, and although I have spared no trouble in comparison and research, some of these have not been settled in a manner quite satisfactory to myself, such as *R. subtetraëdra*, *Lycettii*, *lacunosa*, *Morièrei*, and, perhaps, one or two others.

from its great rarity, I think it desirable to insert a short account of its contents, especially as it will explain the origin of a most important genus in the class of Brachiopoda.

Fischer divides his family of Terebratulæ into four Divisions:—

I. THE TEREBRATULÆ, THE EDGES OF WHICH ARE SMOOTH AND NOT PLAITED, ex. *Ter. ovata* (Fischer), Ency., pl. 239, fig. 2, *T. scabra*, &c.

II. THE TEREBRATULÆ, THE EDGES OF WHICH ARE PLAITED, ex. *Ter. novem-plicata* (Fischer), and *Ter. octoplicata*; this last the author figures, and it is a specimen of *Spirifer Walcottii*, and is stated to be so in his other Work, '*Ortyctographie du Gouv. de Moscou*,' 1830—37, p. 41.

III. THE TRILOBATED TEREBRATULÆ, Genus TRIGONELLA.

"The margin of the trilobated Terebratulæ presents a considerable displacement in the middle, the result being a division into three lobes; the impression of the middle is either smooth or striated. I distinguish these striations by parts (*τρῶν*), so that one recognises at once, by the name of the species, that they belong to the trilobated *Terebratulæ*, where the contour of the edges is not on the same level."

Of this proposed genus, Fischer names five types; the first is *Ter. atoma*, (Fischer, referring to 'Knorr. Petref.' vol. ii, p. 1, B. iii, fig. 6,) but on examining this reference, I am at a loss to know what the type *Ter. atoma* is, as B. iii, fig. 6, does not look like any form of Brachiopod, and can be of no use. The next is *T. bitoma*, stating that Lister's fig. 7, tab. 450 A, bears much resemblance to his type; this also I cannot distinguish, that author's figure being so imperfect. Fischer's next two types, *T. pentatoma* and *tritona*, are figured by himself, but are specifically undeterminable from the vagueness of the illustrations; they belong, however, to that section, with the two small calcareous bent processes, as in *T. psittacea*; the last-named, or the fifth type, *T. polytoma*, is a *Spirifer*. 'Ency. Meth.,' tab. 244, fig. 4 ^a ^b.

IV. RHYNCHONELLÆ, p 35.

"The Terebratulæ, the medial edges of which are so elongated as to assume the form of a beak. The extremity of the beaked edge being on the same level with the foramen. These shells doubtless form a distinct genus, characterised as follows: *Shell bivalve, regular, with unequal valves, fixing itself by means of a*

I have, however, ventured to arrange our British specimens into thirty species, as seen in the following Table, uniting at the same time, by a line, those forms more nearly connected, a few of which may be only modifications of one great type.

{	1.	Rhynchonella Wrightii.	{	16.	Rhynchonella varians.
	2.	— furcillata.		17.	— Forbesei.
{	3.	— rimosa.		18.	— serrata.
	4.	— spinosa.		19.	— plicatella.
{	5.	— senticosa.		20.	— inconstans.
	6.	— ringens.		21.	— concinna.
{	7.	— subringens.		22.	— subconcinna.
	8.	— acuta.	{	23.	— obsoleta.
{	9.	— cynocephala.		24.	— subobsoleta.
	10.	— variabilis.		25.	— angulata.
{	11.	— subvariabilis.		26.	— Morièrei.
	12.	— Lycettii.	{	27.	— tetraëdra.
{	13.	— oolitica.		28.	— subtetraëdra.
	14.	— Moorei.	{	29.	— lacunosa ?
	15.	— Bouchardii.		30.	— Hopkinsii.

By simply glancing at the Table inserted at the end of this Monograph, we may perceive how differently the types are distributed in the various subdivisions of the system. The Inferior Oolite contains the greatest numerical amount of species and individuals; in the

ligament, or a short tube; the smaller valve perforated, its summit not much produced, or recurved; hinge with . . . teeth. The Terebratulæ with a perforated beak, therefore, form a very distinct family, the *Trigonellæ* and the *Rhynchonellæ* being distinguished by their general aspect, and by their hinges, which have not been, as yet, investigated."

"27 *Gros bec*. The largest valve is that which, in other Terebratulæ, is the smallest; has two teeth and an arched contour.

"*Rhynchonella loxia* Miki. Valva major bidentata margine terminali in curvo. Tab. ii, figs. 5, 6, loc. Talaroba.

"*Rhynchonella Canard*, 'Ency.,' tab. 245, fig. 6^{ab}°.

"*Rhynchonella Aigle*, 'Ency.,' tab. 246."

The first, *R. loxia*, he illustrates, and it is a well-known Oolitic species found abundantly in the neighbourhood of Moscow, and resembling in general form *R. acuta*, but is a smaller shell with some other differences, well figured by M. D'Orbigny in Pl. xlii, figs. 22 and 25 of the 'Geol. of Russia,' under the erroneous name of *T. aptyca*, a mistake corrected by the same author in his 'Prodrome.'

All three are possessed of the same two short-curved appendages, as in *T. psittacea*. From the above, it may be perceived that three of the types of Fischer's genus *Trigonella*, and his three *Rhynchonellæ* are similarly organised, and consequently belong to the same genus; the one is synonymous of the other. M. D'Orbigny having adopted the last, and judiciously placed in it a vast number of species, and this being admitted by other authors, I will abide by the genus *Rhynchonella*, and place *Trigonella* as a synonym, although, perhaps, that name ought to have been preferred, being first mentioned in the paper; but it is evident, that to bring about this *most useless change*, it would be necessary to re-shift all the species now well known as *Rhynchonellæ*, which in my opinion would be ridiculous, and in no way serving science; later in 1830—37, Fischer notices *Ter. acuta*, Sow., *Ter. ringens*, V. Buch, and *Ter. variabilis*, Schl., as other

other divisions up to the Portland Oolite, or uppermost member of the series, the number of species diminish, and in some beds, only one or two forms have yet been noticed; thus in the Kimmeridge Clay, I am only acquainted with two, *R. inconstans* and *R. subvariabilis*; in the Portland beds, none seem as yet to have been discovered. Certain forms are rare, others very common. Among the former, I may mention *R. Wrightii*, *furcillata*, *subvariabilis*, *ringens*, *serrata*, and among the latter, *R. concinna*, *obsoleta*, *acuta*, *varians*, *variabilis*, *inconstans*, *spinosa*, and *tetraedra*; if, again, we glance over our table to see what takes place among the other genera, especially the *Terebratulæ*, we observe a similar poverty of species and individuals in the upper portions of the Oolitic system. There existed, therefore, at that period, a sea, and circumstances more favorable to the development of this class of Mollusca, which after diminishing appeared again in the Cretaceous epoch in vast numbers. I may conclude these few remarks by stating, that from the extreme variability of shape in this most difficult genus, it is at times scarcely possible to compare specimens with figures; and the more so when the latter are unexact or executed so carelessly as to place one in great doubt as to the types intended; this is proved by the multitude of erroneous determinations or synonyms filling most Geological and Palæontological works; the mistaken identification of species attributed to Sowerby and Lamarck, would alone fill the space of several sheets, nor should I have been able to determine many of the shells which have come under my notice, had I not been assisted in my comparisons by the original specimens of the 'Min. Con.,' and those of Lamarck, &c.

examples of his genus *Rhynchonella*, while not one of the types of *Trigonellæ* can be safely identified, excepting the last, which is a true and well-known *Spirifer*; it appears, likewise, that in 1778, Da Costa proposed a genus *Trigonella* for a *Mactra*, and De Candolle the same for a section of Plants.

DAVILA, in 1767 ('*Catalogue Systematique et Raisonné des Curiosités de la Nature*,') gives a few good illustrations of some recent *Terebratulæ*, and shows, by his various observations, that he had not neglected to remark the differences of the internal apophysary system between the true *Terebratulæ* and *Rhynchonellæ* while describing his *Bec de Perroquet*, the name by which *R. psittacea* was then well known; he alludes to the hinge, and the two short lamella.

In 1712, Morton ('*Nat. Hist. of Northamptonshire*,') perceived the necessity of separating the plaited *Terebratulæ* from the smooth ones. He adds, p. 211, "The head or beak of the longer of which valves is crooked, and lies over the top of the other valve: of these, there are two general divisions, the smooth and the striated; the smooth have generally a rounder and blunter beak, the end of which in most of them is, as it were, bored, from whence it was called *Terebratula* by Lhwyd, in his '*Lithop. Brit.*' Some have a rounded, others a straight margin in the second division, the striated ones have generally a sharper beak than the former;" this shows, that so far back as 1712, the necessity of separating the *Rhynchonellæ* from the true *Terebratulæ* was appreciated.

For further details, refer to 'Introduction,' and the article '*Rhynchonella*,' in Parts I and II, where numerous illustrative figures are given, and to my paper in the '*Ann. and Mag. of Nat. Hist.*,' April 1852.

62. RHYNCHONELLA WRIGHTII, *Dav.* Plate XIV, fig. 1.

Diagnosis. Shell inequivalved, spherical, almost as broad as long; larger valve moderately convex; beak acute, not much produced; foramen small, almost entirely surrounded by the deltidium, a small portion being completed by the umbo; imperforated valve very convex, gibbous; hinge margin slightly indenting the smaller valve; exterior striated and plaited, the striæ which cover all the surface longitudinally are very numerous, minute, and irregular, sometimes bifurcating, nine or ten occupying the width of a line; the plaits only appear on the anterior half of the valves, eleven or thirteen in number, three of which form a well-defined mesial fold, and two in the sinus of larger valve; structure unpunctuated; length 18, breadth $16\frac{1}{2}$, depth 15 lines.

Obs. This fine species was discovered by Dr. Wright in the inferior Oolite of Leckhampton Hill, along with *Ter. simplex* and *T. plicata*; it is quite distinct from *R. furcillata* and *R. rimosa*, although belonging to the same small group; it appears to be very rare, and has not yet been noticed on the continent; the specimen figured is from the collection of Dr. Wright.

63. RHYNCHONELLA FURCILLATA, *Theodori*, Sp. Plate XIV, figs. 2, 3, 4, 5.

TEREBRATULA FURCILLATA, *Theodori*; *de Buch*, 1834. *Über Terebrateln*; et *Mém. de la Soc. Géol. de France*, 1838, vol. iii, 1st series, p. 143, pl. xiv, fig. 13.

— — *Ræmer*, 1836—38. *Die Versteinerungen des Norddeutschen Oolithen-gebirges* Tafel. xiii, fig. 2.

— — *C. Rouillier*, 1847. *Bull. de la Soc. Imp. de Moscow*.

— — *Bronn*. *Index Pal.*, 1848, p. 1237.

RHYNCHONELLA FURCILLATA, *D'Orbigny*, 1849. *Prodrome*, vol. i, p. 239.

Diagnosis. Shell inequivalved, transverse, wider than long; large valve slightly convex, beak acute, produced, not much recurved; foramen entirely surrounded by the deltidium, which also presents a slight tubular expansion; false area generally well defined; hinge margin not much indenting the smaller valve; sinus deep. Smaller valve most convex at the umbo, which is also the deepest part of the shell; the mesial fold is well defined, the sides sloping rapidly downwards. The posterior halves of the valves are ornamented by a variable number of small plaits, from forty to sixty, most of these uniting by two, three, and four, towards the middle of the valves, form large angular costæ, which extend to the margin; the number of these last also varies on the mesial fold, which is composed in different specimens of two, three, four, five, six, and seven plaits. Structure unpunctuated.

Length 10, breadth 12, depth 8 lines.

Obs. It is stated, that *Theodori* first named this shell in his collection, which name was

subsequently adopted by V. Buch, who both described and figured the shell. Few authors have seemingly noticed it; and it is a rare species in England, where it has been found by Mr. Moore in the Marlstone of Ilminster, and appears also to occur in beds of the same age near Cheltenham. In Pl. XIV, I have illustrated varieties, with two, three, four, and five plaits, on the mesial fold. In France, it is found in Normandy, at Fontaine-Etoupefour, near Caen, at Pinperdu, near Salins (Jura), at Allem, Bahlingen, and Neuffen, Wurtemberg, &c., in Germany; it is generally found in company with *Rh. rimosa*, into which it seems sometimes to pass by insensible gradations.

64. *RHYNCHONELLA RIMOSA*, *De Buch*, Sp. Plate XIV, fig. 6, 6^a.

- TEREBRATULA RIMOSA*, *De Buch*, 1831. *Petrifications Remarquables*, pl. vii, fig. 5; et 1834, *Über Terebrateln*; et 1838, *Mém. de la Soc. Géol. de France*, vol. iii, 1st ser., plate xiv, fig. 12.
- — *Zieten*, 1832. *Dei Versteinerungen Württembergs*, tab. xlii, fig. 5.
- — *Deshayes*, 1836. *Nouv. Ed. de Lamarek*, vol. vii, p. 354, No. 70.
- — *C. Rouillier*, 1837. *Bull. de la Soc. Imp. de Moscou*, No. 11.
- — *Morris*. *Catalogue*, 1843.
- — *Bronn*. *Leth. Géog.*, 1837, p. 292, tab. xviii, fig. 6.
- — *Ibid.*, 1848. *Index Pal.*, p. 1249.
- RHYNCHONELLA RIMOSA*, *D'Orb.* 1849. *Prodrome*, vol. i, p. 239.

Diagnosis. Shell more or less circular, almost spherical, generally as wide as long; valves convex, gibbous, deepest near the umbo; beak acute, much recurved, almost touching the umbo, and allowing very little space for the passage of the muscular fibres composing the pedicle. The deltidial plates entirely surround the foramen, which is small, and almost touches the umbo; hinge margin indenting the smaller valve; sinus and mesial fold well defined, valves ornamented by a considerable number of small plaits, which, after proceeding from the beak and umbo towards the middle of the valve, in most cases unite by two or three, to form larger and deeper plaits or costæ, which extend to the margin; thirteen or fourteen of these are visible on each valve; two, three, or four, forming the mesial fold; structure unpunctuated. Length 8, width 8, depth 6 lines.

Obs. *R. rimosa* is distinguished from *R. furcillata* by its smaller dimensions and more spherical form, it is much less wide than *furcillata*, its beak is more recurved and ornamented by fewer plaits; these unite in a very irregular manner, some before others, while a few either soon disappear or proceed from the umbo to the margin, without uniting into large costæ. MM. C. Rouillier and A. Vossinsky have proposed to establish a small separate group for *R. rimosa* and *R. furcillata*, under the name of *duplicata*,¹ to distinguish

¹ Etudes progressives sur la Palæontologie des Environs de Moscou. Bulletin de la Soc. Imp. des Naturalistes de Moscou, année 1847, No. 11.

the peculiar disposition of the plaits in the *duplicatae*, forming a natural passage by means of the *plicosa* into the *dichotomae*; these authors are, however, mistaken, in stating that the small group in question belongs exclusively to the Lias period, as several similar species are found in the Cretaceous beds, such as *R. antidichotoma* (Bouvignier), &c., and *T. Schnurii* (de Ver) from the Devonian Rocks.

Both *R. rimosa* and *furcellata* are generally found in the same localities in the Middle Lias,¹ but in England they are rather uncommon fossils; I have found *R. rimosa* in the Lias at Farrington Gurney, near Radstock, also near Cheltenham, and it has likewise been met with near Whitby. In France, it is common at Vieux Pont, Fontaine-Etoupefour, &c., near Caen, at St. Amand (Cher), at Bajac, Castellane (Lower Alps); and it is stated by Von Buch and Mr. Fraas to occur plentifully in many German localities, such as Bahlingen in Wurtemberg, in the stream of Pliensbach, Amberg, Allem, &c.: fig. 6, nat. size; fig. 6^a, enlarged.

65. RHYNCHONELLA SPINOSA, *Schloth.*, Sp. Plate XV, figs. 15—20.

TEREBRATULITES SPINOSUS, *Schlotheim*, 1813. Beiträge zur Naturgeschichte der Versteinerungen in Leonhards, Mineral Taschenbach, vol. vii. Refer to Knorr's fig. in Lapides Diluvii Universalis Testes, 1755, tab. B iv, fig. 4.

TEREBRATULA SPINOSA, *Smith*, 1816. Stratigraphical System of Organised Fossils, p. 108.

— SENTICOSUS, *Schl.* 1820. Der Petrefac., p. 268, No. 30.

TEREBRATULA ASPERA, *Kœnig*, 1825. Icon. Sect., No. 219.

— SPINOSA, *Lamarck*, 1819. An. sans Vert., vol. vi, No. 52; and Dav., Notes on the Species of Lamarck, An. and Mag. of Nat. Hist., 1850.

— — *Von Buch*, 1834. Über Ter.; and 1838, Mém. de la Soc. Géol. de France, 1^{re} ser., p. 161, pl. xvi, fig. 4.

— — *Defrance*, 1828. Vol. liii, Dic. d'Hist. Nat., p. 161.

— — *Zieten*, 1832. Die Vers., Würt., p. xlv, fig. 1.

— — *Deslongchamps*, 1837. Soc. Linn. de Normandie, p. 30.

— — *Phillips*, 1835. Geol. of York, vol. i, pl. ix, fig. 18.

— — *Bronn*. Leth. Géog., 1837, p. 296, tab. xviii, fig. 2.

— — *Quenstedt*, 1843. Flözgebirge.

— — *Morris*, 1843. Catalogue.

— — *Tennant*, 1847. A Stratigraphical List of Br. Foss., p. 74.

— — *Bronn*. Index Pal., 1848, p. 1251.

HEMITHIRIS SPINOSA, *D'Orb.* 1849. Prodrome, vol. i, p. 286.

ACANTHOTHIS SPINOSA, *D'Orb.* Pal. Franç. Ter. Crétacées, vol. iv, p. 343, 1847, (but published later.)

¹ In a very interesting paper 'On the Comparison of the German Jura Formations with those of France and England,' by M. Oscar Fraas, (Leonhard's and Bronn's Neues Jahrbuch, f. Min., U.S.W., 1850, 2 H, pp. 138—185,) this species is particularly noticed as a most characteristic form in the *Middle Black Jura* in all countries, and is stated to be always found with *T. numismalis*. I cannot, however, believe with that author, that *T. digona* and *T. lagenalis* were found so low down as the Middle Lias.

Diagnosis. Shell transverse; wider than long, more or less spherical; the smaller valve convex, even gibbous, attaining its greatest height before reaching the middle of the valve; the plaits on the mesial fold do not project much above the lateral ones. Larger valve convex, exhibiting a wide sinus more or less defined, and extending to the front; the margin forming a convex line in that portion. The beak is small and acute, under which, especially in young shells, the foramen is visible, almost surrounded by the deltidial plates, except in a small portion, which is completed by the umbo; in adult shells the beak becomes so much recurved, that hardly any space remains between it and the umbo for the passage of the peduncular fibres; surface of valves ornamented by a variable number of plaits of greater or less depth, not increasing much in width as they proceed from the beak and umbo to the front; sometimes they are seen to bifurcate, but generally this appearance is more due to the interposition of a new plait between the regular costæ at variable distances, than to true bifurcation: from distance to distance along the ridge of each plait are seen to proceed long slender tubular spines, arising from an expanded base, and at times exceeding six or nine lines in length; their number is very variable, as well as the regularity of their disposition.

Length 13, width 15, depth 11 lines.

Obs. This is a well-known inferior Oolite shell, figured but not named by Knorr,¹ in 1755, by Walch and Knorr in 1768,² and by Captain Walcott in 1799.³ It varies so much in the number, width, and depth of its plaits, as to have tempted some authors to divide them into more than one species. In some specimens I have counted forty-six plaits on each valve, while others offer fewer, sometimes only twenty; to this variety M. D'Orbigny has given the name of *costata*.⁴

I do not agree with that author in placing this shell in the genus *Hemithyris*, from the supposition that it had no deltidial plates, which is a mistake; nor do I admit that the genus *Hemithyris* is in itself distinct from the *Rhynchonella*, as even in *R. psittacea* the deltidium is visible, although in a less extended shape.⁵

¹ Lapidés Diluvii Universalis, tab. B iv, fig. 4.

² Die Naturgeschichte der Verst., id.

³ Descriptions and Figures of Petrifications found near Bath, fig. 31.

⁴ Prodrome, vol. i, p. 286.

⁵ On reading over the article *Hemithyris*, Pal. Franç., Ter. Crétacées, vol. iv, p. 342, 1847, M. D'Orbigny states: "This genus is very nearly related to *Rhynchonella*, and is only distinguished by its foramen contiguous to the hinge, and no deltidium. We believe that two distinct genera may be established in this division. The name of *Hemithyris* may be preserved for those species with a fibrous texture, and without pores or exterior spines, the genus thus circumscribed with the recent form (*H. psittacea*) would number 17 species, the first are silurian . . . to the species, likewise, of fibrous texture, but provided with tubular spines, scattered or in lines, we will apply the name of *Acanthothyris*. We place in this the *Acanthothyris spinosa*, D'Orbigny; and *costata*, D'Orbigny; and *senticosa*, inscribed in our 'Prodrome' under the name of *Hemithyris*." But, as may be seen by referring to the article, *Rhynchonella*, Part I, I cannot admit the three genera proposed for shells all similarly organised. Besides which, M. D'Orbigny places, in the genus *Rhynchonella*, many species, the deltidium of which is not tubular, and species having the beak

It is probable that, when alive, *R. spinosa* was more or less coloured with red ; at least, we have seen many specimens, in which the spines had preserved that colour; this is also the opinion of M. Deslongchamps, and it is alluded to by V. Buch in his description of the species. *R. spinosa* is found in the inferior Oolite of many localities, as at Dundry, near Bath, Minchinhampton, Cheltenham, &c., where many fine specimens, with the spines preserved, have been discovered by Dr. Wright, and Messrs. Lycett, Walton, and others, a fine series of all the varieties may be seen in the Museum of the Bristol Institution.

In France it abounds; in Normandy, at Falaise, Moustiers, Port-en-Bessin, Sturfenberg, and many other German localities.

Fig. 15. A specimen, with its spines.

„ 16^a. A variety, with few plaits, from Dundry.

„ 17, 18. Enlarged representations of the beak, foramen, and deltidium.

„ 19. Is drawn from a specimen in Dr. Wright's collection.

„ 20. From a young specimen, showing the dichotomizing and intercalation of some of the plaits.

66. RHYNCHONELLA SENTICOSA, *V. Buch*, Sp. Plate XV, fig. 21.

TEREBRATULA SENTICOSA, *Von Buch*, 1834. *Über Terebrateln*; and 1838, *Mém. de la Soc. Geol. de France*, vol. iii, p. 162, (non *Ter. senticosa*, Schloth., which is a synonym of *Spinusus* of the same author.)

Diagnosis. Shell transversely oval, depressed, wider than long; valves convex; beak small, acute, not much produced or recurved; foramen nearly surrounded by the deltidial plates; a small portion only being completed by the umbo; marginal line nearly straight, slightly curved in front, but not producing any distinct mesial fold or sinus; valves ornamented by a vast number of minute longitudinal ridges, on which are implanted a vast number of small tubular spines covering the whole surface; from twenty to twenty-four occupying the space of a square line; lines of growth strongly marked. Length 11, width 13, depth 7 lines.

Obs. The first mention of the term *senticosa*, is by Schlotheim,¹ who refers to Knorr's figure,² which, as we have already remarked elsewhere, was the type of *R. spinusus*, so named by Schlotheim in 1813,³ *T. senticosa* of that author is therefore only a synonym. At

so much incurved, as to lie close on the umbo, and therefore showing no tubular foramen, such as *Rh. tetraëdra*, &c., and others, such as *R. concinna*, where the foramen is not tubular, nor even entirely surrounded by the deltidium, a portion being completed by the umbo.

¹ *Die Petrifactendunde*, 1820, p. 268, No. 30.

² *Knorr Lapides diluvii*, 1755, pl. B. W., fig. 4.

³ *Schlotheim Beiträge zur Natur. Vers.*, in *Dr. Leonhard's Min. Tasch.*, vol. vii.

a later period, Baron Von Buch distinguished the shell above described from *R. spinosa*,¹ and applied to it the name of *senticosa*, which I have adopted for the present form to avoid the introduction of another appellation for the species under notice. It is also, probable, that Zieten's *Ter. spinosa*² may belong to the present form, as it does not seem to present the characters of the true *spinosa*, and although both of these species are somewhat allied, they should always be considered as distinct, *R. senticosa* being a much more transverse and more depressed shell; the beak is smaller, and the surface ornamented by a greater number of slender spines, while in *R. spinosa* the shell is more spherical, the beak rounded and more recurved, the surface being also not only spinose but plaited. Both species seem to occur in the same localities, viz., in the lowest beds of the Inferior Oolite of Dinnington and Burton Radstock, where they were collected by Mr. Moore. On the Continent, it is common in beds of the same age, at Curcy, Moutiers, &c., in Normandy, and is likewise stated to occur at Grumbach, near Amberg, by Baron Von Buch, in the inferior Oolite beds above the Lias. M. D'Orbigny does not seem to have noticed this species in the Inferior Oolite (*T. Bajocean*)³ where the type commonly occurs, but places it in the Oxford Clay,⁴ where, according to MM. Bouchard and Moreau, the species is likewise found in the Departement de l'Yonne; I have not, however, had the advantage of seeing any of those specimens, but from M. D'Orbigny referring to Baron Von Buch, and giving his locality *Grumbach*, it is probable that it is the same species; none, however, have yet been noticed in our English Oxford Clay.

67. RHYNCHONELLA RINGENS, *Herault*, Sp. Plate XIV, figs. 13, 14, 15, 16.

TEREBRATULA GRIMACE, *Herault*.

— RINGENS, *V. Buch*, 1834. *Über Terebrateln*; et Mém. de la Soc. Geol. de France, 1838, vol. iii, 1re ser., pl. xiv, fig. 3.

— — *Deshayes*, 1836. *Nouv. ed. de Lamarck*, p. 312, No. 65.

— — *Bronn*, 1848. *Index Pal.*, p. 1249.

RHYNCHONELLA RINGENS, *D'Orb.*, 1849. *Prodrome*, vol. i, p. 258.

Diagnosis. Shell remarkably shaped, the depth exceeding the width and length; the smaller valve rises suddenly from the umbo to the front by an almost perpendicular convex curve, forming a large rounded central plait or elevated mesial fold, bent downwards at its extremity, which lies over to meet the sinus of the perforated valve; on either side of the mesial fold three or four smaller lateral plaits form a regular curve from near the umbo to the margin. In larger valve, the beak is small, acute, and not much recurved; the foramen is entirely surrounded by the deltidial plates, but not remarkably separated from

¹ *Über Terebrateln*, 1834, vol. vii, 1813.

² *Zieten Wurtemb. Verst.*, p. 44, fig. 1, 1832.

³ *Prodrome*, vol. i, p. 286.

⁴ *Ib.*, p. 375.

the umbo; the hinge margin of larger valve not much indenting the imperforated one. The sinus begins to appear at a short distance from the beak, when it soon turns up almost perpendicularly in the shape of a narrow tongue to meet the bent downward extremity of the mesial fold. The sinus is divided longitudinally by a groove which becomes deeper as it approaches the extremity, the anterior portion of the sinus thus presenting two convex rounded costæ, much depressing the level of the lateral margin of the mesial fold; three or four small lateral plaits existing likewise on each side of the sinus in this valve. Structure unpunctuated. Length 6, width 7, depth 8 lines.

Obs. This species was discovered by M. Herault, engineer of the Mines, and he gave to it the name of *Ter. grimace*, afterwards translated to the Latin name of *Ter. ringens*, by Von Buch, to whom we are indebted for the figure and description of the shell.

It is only lately, that this form has been noticed in England, where it was discovered in the Inferior Oolite of Yeovil, Sherburn, Greenland, &c., in Gloucestershire by the Officers of the Geological Survey, to whom I am indebted for the loan of the specimens (figs. 13 and 14) illustrated in Pl. XIV. On the Continent, the shell is found in the Inferior Oolite of Moutiers, near Caen.

In England, this species does not appear to have attained the dimensions of the French shells, they are not as thick or rounded, seem more angular, and are, perhaps, more properly speaking, a variety of the original type. Fig. 15 represents the Norman type. Fig. 16 is given to show, that, although the great character of the species under consideration is to have a single plait in the elevated mesial fold, still in some rare cases it may become bidentated, and even tridentated, as may be seen in the remarkable specimen kindly lent me by M. Deslongchamps; a similar variation from the common type has been noticed in *R. cynocephala*, and in other species.

R. ringens is placed by M. D'Orbigny¹ in the Upper Lias (Terrain Toarcien), I believe it to be, however, more properly located in the lower beds of the Inferior Oolite.

68. RHYNCHONELLA SUBRINGENS, *Dav.* Plate XIV, figs. 17, 17^{a b c}.

Diagnosis. Shell irregularly globular, as wide as long and deep; beak acute, much recurved, overlying, and almost touching the umbo, concealing the foramen and leaving little space for the passage of the pedicle muscular fibres; valves convex, gibbous, and ornamented by seven large, strongly indented costæ in the smaller, and six in the larger valve, proceeding from the umbo and beak to the front and sides; in smaller valve, a large central, more elevated plait forms a mesial fold, to which corresponds a deep sinus in the other one. Structure imperforated; length 4, width 4, depth 4 lines.

Obs. This little shell has been obtained from the Inferior Oolite of Somersetshire by the Officers of the Geological Survey. It seems to differ from *R. ringens*, with which it

¹ Prodrôme, vol. i, p. 258.

was found, by its regular and more indented plaits proceeding from the beak and umbo, while in *R. ringens* they appear at a greater distance. It differs also in general shape, as may easily be perceived on comparing the respective figures of these species. It bears, however, some resemblance to the above-named form by its sinus being likewise strongly marked by a central longitudinal line.

Plate XIV, fig. 17. From a specimen in the collection of the Museum of Practical Geology.

fig. 17^{a b c}. Enlarged illustrations.

69. *RHYNCHONELLA ACUTA*, Sow. Sp. Plate XIV, figs. 8, 9.

- TEREBRATULA ACUTA*, Sowerby. Min. Con., 1818, vol. ii, p. 115, tab. 151, figs. 1, 2.
 — — *Schloth.* System. Ver. der Petref., 1832.
 — — *Deshayes*, 1836. Nouv. Ed. de Lamarck, vol. vii, No. 69, p. 353.
 — — *V. Buch.* Über Terebrateln, 1834; et Mém. Soc. Géol. de France, 1838, vol. iii, 1^{re} ser., p. 142, pl. xiv, fig. 11.
 — — *Phillips*, 1835. Geol. of York., pl. xiii, fig. 25.
 — — *Deslongchamps*, 1837. Soc. Linn. de Normandie, p. 30.
 — — *Morris*, 1843. Catalogue.
 — — *Bronn*, 1848. Index Pal., p. 1228; figured also in the 'Encyc. Meth.,' pl. 255, fig. 7.

Diagnosis. Shell inequivalved, more or less triangular, wider than long, the smaller valve rising in an almost straight line from the umbo to the margin, and forming a large central acutangular plait, the sides sloping rapidly in the manner of a roof; two or three other smaller lateral costæ exist on each side, the first of which is larger than the other two, and can be traced almost from the umbo; in the perforated valve a deep sinus is seen, which corresponds with the central plait of smaller valve; there exists also three lateral costæ. The beak is small, acute, and not much produced, with foramen entirely surrounded by the deltidial plates; margin of the valves deeply sinuated, hinge margin of larger valve not much indenting the smaller one; structure unpunctuated. Length 10, width 13, depth 11 lines.

Obs. *R. acuta* occurs abundantly in the Marlstone, or Middle Lias of Ilminster, in Yorkshire, Wilton Castle, Rilsdale, &c. On the continent it is met with at Landes, Vieux Pont, Evrecy, &c., in Normandy, and does not appear to vary much in shape, being always easily recognised.

In the Oxford Clay of Koroskovo, near Moscow, in Russia, we find a small shell, which received from Fisher, in 1809, the name of *Rhynchonella loxia*, on which type the genus appears to have been established later; 1843 the same author gave to the same shell the name of *Aptyca*: it bears the greatest possible outward resemblance to *R. acuta*, of Sowerby; but, as stated by M. D'Orbigny, can be distinguished¹ by a more marked longitudinal groove in the sinus of the larger valve, visible especially at its extremity, its surface being everywhere

¹ Geology of Russia, t. ii, p. 482, pl. xlii, fig. 22—26.

minutely striated, which is only seen on well-preserved specimens; it is also a smaller species, and found in the Oxford Clay, while *R. acuta* is peculiar to the Middle Lias. The difference between the two forms has been noticed by M. Ch. Rouillier,¹ but we may here mention, that a variety of *Rh. cynocephala*, found in the inferior Oolite of Minchinhampton, with only one central elevated plait, somewhat approaches to *R. acuta*; but besides this shape being unusual to *R. cynocephala*, its lateral costæ are more numerous than those observable in the Sowerby shell.

70. RHYNCHONELLA CYNOCEPHALA, *Richard*, Sp. Plate XIV, figs. 10, 11, 12.

TEREBRATULA CYNOCEPHALA, *Richard*, 1840. Bull. de la Soc. Géol. de France, vol. xi, p. 263, pl. iii, fig. 5 ^{a b c d}.

Diagnosis. Shell inequivalved, nearly as wide as long, more or less irregularly triangular. The smaller or imperforated valve is convex at the umbo, and continues to rise rapidly to the extremity of the margin, with a slight inward curve, forming a narrow, pinched, elevated, and bidentated mesial fold, the sulcus separating the two plaits only appearing in the anterior half of the valve, and increasing in width with little depth to the edge of the front, to which a small plait corresponds in the sinus of the other valve.

At a short distance from the umbo on either side of the elevated mesial fold, the sides of the valves form a descending curve divided by four small lateral plaits on each side; the beak in the larger valve is small, acute, not much recurved, leaving a well-defined false area between the beak ridges and dental margin, in the centre of which, under the beak, a small foramen is visible, surrounded by the deltidial plates, but almost touching the umbo in one point; a regular convex curve is formed from the extremity of the beak to the front, which is in a great measure taken up by a wide sinus; in the middle of it is perceived the small plait above noticed, four lateral costæ also exist on both sides of this valve; they form a slight outward curve at a short distance from the beak, and correspond with those in the smaller valve. Structure imperforated. Length 8, width $8\frac{1}{2}$, depth 7 lines. The width of the sinus is about half the total breadth, the greatest width being also towards the middle of the shell.

Obs. Much confusion and misunderstanding exists relative to this species, which has been considered by many the representative of Professor Phillips's *Ter. bidens*, 'Geol. of York,' Pl. XIII, fig. 24; this is, however, an error, as the illustration given by that author in no way represents the species under consideration, nor does the strata alluded to, "*Marlstone and Ironstone beds*," allow us to mistake the shell of Professor Phillips for *R. cynocephala*, which in England belongs to the Inferior Oolite.² In 1840, Mr. Richard became convinced of this fact, which he then mentioned to me; and, in order to put matters right, described and figured the present form under the name of *T. cynocephala*, from the vague

¹ Etudes Progressives sur la Palæontologie des Environs de Moscou. Par MM. Ch. Rouillier et Alex. Vossinsky. Bull. de la Soc. Imperiale des Naturalistes de Moscou, 1847, No. 11.

² M. de Verneuil has found this species in the Lias of Villas des Covo and Albanaar in Spain.

resemblance this shell presents to a dog's head. Most Palæontologists, singularly enough, have not coincided with Mr. Richard's views, for we see Bronn and others placing *Ter. bidens* with its variation *T. biplicata*, and *T. cynocephala*, in one species, (Index Pal., p. 1251.) Mr. Woodward fully understood the necessity of adopting a distinct name for the shell under notice, and in the collection of the British Museum made use of Mr. Richard's name. In 1828 Young and Bird figured a shell under the name of *Ter. lineata*; but, from want of description and the incorrect illustration, it is impossible to decide as to the shell intended. Through the kindness of Mr. Riply, of Whitby, I was able to convince myself that both *T. bidens*, and *cynocephala*, occur in Yorkshire, but in different beds, and that both species seem perfectly distinct. *R. cynocephala*, as we have above remarked, has for general character the bidentation of its elevated mesial fold; but in some rare cases, the bidentation is replaced by one single elevated plait, as in *R. acuta* (see fig. 10); and in other similarly rare exceptions, instead of the single bidentation, that portion is tridentated, as in fig. 12. I am indebted to Messrs. Lycett and Woodward for specimens confirming this fact in the most positive manner.

R. cynocephala is found in the inferior Oolite of Minchinhampton, Dinnington, Yorkshire, &c.; on the continent it was discovered by Mr. Richard, in the inferior Oolite of Bourmont.

Figs. 10, 11, 12, are drawn from specimens in the collection of the British Museum, and in that of Mr. Lycett.

71. *RHYNCHONELLA VARIABILIS*, *Schloth.*, Sp. Plate XVI, figs. 1—6, and Plate XV, figs. 8—10.

TEREBRATULITES VARIABILIS, *Schlotheim*, 1813. Beiträge zur Naturgeschichte der Versteinerungen in Leonhard's Mineral Tashent, vol. vii, p. i, fig. 4.

— *TRIPLICATA*, *Phillips*, 1835. Illustrations of the Geology of Yorkshire, Part I, p. 157, pl. xiii, fig. 22.

— *BIDENS*, *ibid.*, pl. xiii, fig. 24.

— *TRIPLICATA*, *V. Buch*, 1838. Mém. Soc. Géol. de France, vol. iii, 1re ser., p. 140, pl. xiv, fig. 9.

— *VARIABILIS*, *ibid.*, pl. xiv, fig. 10.

— *TRIPLICATA*, *Deshayes*, 1836. Nouv. Ed. de Lamarck, p. 353.

— *VARIABILIS*, *Pusch*. Polens Palæontologie, 1837, p. 11, pl. iii, fig. 2.

— *TRIPLICATA* and *BIDENS*. *Deslongchamps*, 1837. Soc. Linn. de Normandie, p. 30.

— — *Morris*. Catalogue, 1843.

— — *Tennant*, 1847. A Strat. List of British Fossils, p. 74.

— — *C. Rouillier* and *A. Vossinsky*, 1847. Etudes Prog. sur la Pal. des Env. de Moscou, No. 11, tab. B, fig. 17.

— — *Bronn*, (pars) 1848. Index Pal., p. 1254.

RHYNCHONELLA VARIABILIS, *D'Orbigny*. Prodrome, 1849, vol. i, p. 239.

Diagnosis. Shell variable, irregularly triangular, wider than long; beak acute, more or less produced and recurved; foramen small, entirely surrounded or almost so by the deltidial plates, a very small portion being completed by the umbo, the beak is sometimes so much recurved, as hardly to allow any space for the passage of the pedicle muscular fibres; beak ridges well defined, leaving a flat or concave false area between them and the hinge margin, and not much indenting the smaller valve, which presents an elevated regular convex curve from the umbo to the front, ornamented by a variable number of costæ, two, three, or four in different examples, forming a central elevated mesial fold, corresponding with one, two, or three plaits situated in the sinus of larger valve; on either side of this mesial fold and sinus on both valves are seen three or four lateral costæ, not varying much in number on different specimens, so that the smaller valve may be ornamented by eight, nine, or ten plaits; the number on the mesial fold being independent of those on the sides; the costæ in general becoming visible, and produced only at a little distance from the beak and umbo. Structure unpunctuated; length 10, width 12, depth 9 lines.

Obs. This shell has caused great confusion from its variable shape, no doubt due to local causes; and it is not without many comparisons and researches that I made up my mind to adopt M. D'Orbigny's views, viz., to consider Professor Phillips's *Ter. triplicata* and *bidens* as synonyms of Schlotheim's *T. variabilis*, which species was unfortunately established on a very poor and exceptionable specimen, so that his figure in no way represents the general and well-developed types of the species, so much so, that from not being able to make up my mind to their identity I was led to figure both separately in different plates, but having since re-examined a multitude of examples, and been unable to discover permanent distinguishing characters, I am obliged to admit Schlotheim's priority. It will not, however, be useless to mention some points connected with the history of this species; Von Buch, in his important work on 'Brachiopoda,' admits both *T. variabilis* and *triplicata*, stating at the same time, that the difference between them is very small. Professor Phillips's *Ter. triplicata* and *bidens* belong to the same form, and not to the *R. cynocephala* of Richard, as we have already explained under the description of that species, although both are found in the same neighbourhood, but not in the same beds. *R. variabilis*, or *triplicata* and *bidens*, being only varieties with two or three plaits on the mesial fold, and it is always objectionable to name species from the number of costæ ornamenting their surface, as these constantly vary to a greater or less degree on different specimens, *R. variabilis* presenting at times from two to five plaits on the mesial fold, while the types of Schlotheim and Phillips have but two or three; most writers seem to have retained both these authors' names, while some, as Von Buch, M. Deslongchamps, Professor Bronn, Rouillier,¹ &c., have considered *bidens* and *triplicata* as the same type; but the last two authors

¹ The references are given in the synonyms placed at the head of this description.

are mistaken in some of their synonyms; thus Prof. Bronn is disposed to consider *R. cynocephala*, as perhaps the same, while M. C. Rouillier places *R. acuta* of Sow., as a simple variation of *triplicata* with one plait, and *bidens* as a variety with two on the mesial fold, overlooking the important character distinguishing the Sowerby type, viz., that the central and only plait forms an elevated curve from the umbo to its extremity, so that at the front the plait becomes not only the highest part of the shell, but is even frequently bent upwards, while in *triplicata* the plaits bend downwards long before having reached the frontal margin. A single glance at the respective figures will point out the difference; Mr. Morris has fallen into the same error, since he considers *R. cynocephala* to be Professor Phillips's *T. bidens*. Through the kindness of Mr. Riply of Whitby, I have been enabled to examine the Professor's types, and a numerous suit of specimens illustrating some of its numberless varieties.

We can hardly believe, with Professor Bronn, *T. variabilis* of Schlotheim to be a specimen of *R. rimosa*; it presents none of the characters of that shell. *R. variabilis* belongs to the Middle and Upper Lias, the var. *triplicata* and *bidens* of Phillips being stated by that author to be peculiar to the Marlstone and Ironstone series,¹ Pl. XVI, figs. 1 and 3, illustrating the Professor's types. It is common, likewise, to the Lias of several other British localities, such as near Ilminster and Radstock, where the shell often assumes a considerable degree of variation, as may be perceived in Pl. XIV, figs. 4 and 6, and Pl. XV, figs. 8, 9, 10. These last are more like the type of the species according to Schlotheim's figure, where the frontal margin has become considerably thickened, they are exceptions to the general form. Figs. 4 and 6 of Pl. XVI, are also more convex and compressed laterally, but we can trace all the intermediate passages uniting these extreme points of variation. A dwarfish variety is likewise met with in the Lias of Stonehouse, near Stroud, Pl. XVI, figs. 2 and 5. On the Continent it has been collected in many localities, presenting all the variations found in England, and is not rare in the Upper Lias of Croisilles and Subles, near Caen, and Bayeux in Normandy, also at Amberg, and I have specimens sent me by Dr. Krantz, from Kirchum, in Wurtemberg, and from Khoroschova, near Moscow, in Russia.

72. *RHYNCHONELLA SUBVARIABILIS*, *Dav.* Plate XV, fig. 7; and Plate XVIII, fig. 11.

Diagnosis. Shell transversely irregularly oval, wider than long; beak not much produced, acute and slightly recurved, leaving a flat false area between its ridges and the hinge margin; foramen small, almost entirely surrounded by the deltidium, a small portion only being completed by the umbo. Valves convex, ornamented by 9 or 11 plaits,

¹ The specimens of this species from the Ironstone bands rarely preserve the shells, which present a more or less advanced state of decomposition, exhibiting those longitudinal asbestoid fibres mentioned by M. C. Rouillier, in his 'Etudes Progressives sur la Palæontologie des Env. de Moscou,' 1847.

2 or 3 in the smaller valve forming an elevated mesial fold, with 1 or 2 in the sinus. Surface minutely longitudinally striated; the concentric lines of growth intersecting the striæ so closely, as to give them a squamose wrinkled aspect, especially as they become more defined and projecting towards the margins. Length $8\frac{1}{2}$, width $9\frac{1}{2}$, depth 7 lines.

Obs. This species belongs to the Kimmeridge Clay, of Pottern, Wilts, where it was found by Mr. Cunnington, and bears so great an external resemblance to some varieties of *R. variabilis*, Schl., that we might easily mistake it for that species; but, on examining with care the structure of the shell under notice, we find that, besides the larger costæ, the surface is longitudinally striated, and intersected by closely and roughly disposed squamose concentric lines of growth.

The examples figured are from the collection of Mr. Cunnington, three of which may be likewise seen in the British Museum; from not having had the two specimens at the same time, we were obliged to figure them in different plates, the last one, Pl. XVIII, fig. 11, presented only two plaits on the sinus, while the one figured in Pl. XV, fig. 7, possesses three.

73. RHYNCHONELLA LYCETTII, *Dav.* Plate XV, fig. 6.

Diagnosis. Shell inequivalved, transversely oval, wider than long, beak produced, rounded, slightly recurved at its extremity, foramen circular, entirely surrounded by the deltidial plates; beak ridges well defined, leaving between them and the hinge margin a flat space or false area not indenting the smaller valve. The imperforated valve is regularly convex from the umbo to the front, the deepest portion of the shell being towards the middle, surface ornamented by eleven or thirteen large and deep costæ, three of which form a mesial fold elevated above the lateral plaits, and corresponding with two in the sinus of larger valve. The edge in some specimens is thickened, forming a receding margin all round, so that the extremity of the plaits project further than the junction of the valves. Structure unpunctuated. Length 11, width 13, depth 7 lines.

Obs. This species seems distinguished from *R. variabilis* by its more transversely oval shape and rounded beak, it was discovered by Mr. Lycett in the middle division of the Inferior Oolite of Minchinhampton, where it is very rare.

Fig. 6. From the collection of Mr. Lycett.

74. RHYNCHONELLA OOLITICA, *Dav.* Plate XIV, fig. 7.

Diagnosis. Shell irregularly triangular, nearly as wide as long; beak acute, and not much recurved, leaving a flat, false area between its ridges and the hinge margin; foramen small, circular, entirely surrounded, and separated from the umbo by the deltidial plates;

hinge margin of larger valve indenting that of smaller valve; valves ornamented by rounded costæ, variable in number, proceeding from the beak and the umbo to the front and sides, but faintly marked at their origin; twelve or thirteen on each valve, four or five of which in general form the mesial fold, to which a sinus and plaits in the other valve correspond; structure imperforated; length 6, width 6, depth 4 lines.

Obs. This shell is abundant in the Free Stone above the Pea Grit, in the Inferior Oolite of Leckhampton Hill, near Cheltenham, where it was discovered by Dr. Wright; its plaits become distinct only towards the centre of the valves from which they proceed to the front and sides; *R. oolitica*, somewhat resembles certain varieties of *R. variabilis*, or rather the variation *triplicata* of Phillips, found in the Lias near Radstock, but in the last the beak is wider and more circular than in that of *R. oolitica*, which is generally acute and tapering; the valves being likewise less convex and widest at their anterior portion.

Plate XIV, fig. 7. A specimen natural size, from the collection of Dr. Wright.
fig. 7^d. The same enlarged.

75. *RHYNCHONELLA MOOREI*, *Dav.* Plate XV, figs. 11—14.

Diagnosis. Shell inequivalved, circular, nearly as wide as long; beak acute, not much produced, more or less recurved; foramen small, entirely surrounded by the deltidial plates; beak-ridges well defined; hinge line not much indenting that of the smaller valve; valves convex, slightly depressed, and ornamented by a variable number of radiating plaits, from eleven to eighteen on each valve, three, four, five, six, and even seven forming a slightly produced mesial fold with corresponding plaits in a similarly shallow sinus. Structure unpunctuated; length 7, width 8, depth 5 lines.

Obs. This little species was found by Mr. Moore in the Upper Lias, near Ilminster, and in the same beds at Tor Hill, Glastonbury. It seems to me quite distinct from *R. variabilis*, being more circular, less convex, and ornamented in general by a much greater number of plaits; I have examined examples of all ages, from one line in length up to seven, which seems to be the largest dimensions it attains. In such variable shells as most *Rhynchonellæ*, it is often very difficult to describe certain differences in the general aspect, compared with those presented by other species closely approaching them, and which appear to be distinct.

The specimens figured are principally from Mr. Moore's collection.

76. *RHYNCHONELLA BOUCHARDII*, *Dav.* Plate XV, figs. 3—5.

Diagnosis. Shell circular, semi-globose, as wide as long, valves almost equally convex; beak acute, moderately produced, rounded and more or less recurved; foramen entirely

surrounded by the deltidial plates projecting in a tubular shape round the perforation; beak ridges not very distinct, the false area between them and the hinge margin being small, and not much indenting the smaller valve; valves smooth in the young shell, and ornamented at a more advanced period by only a few rounded plaits appearing towards the margin, viz., two or three, rarely more, forming a kind of mesial fold, to which one or two plaits in the sinus of the larger valve correspond; likewise the sinus only appears near the margin or in the anterior portion of the shell; on either side on both valves, three or four similarly disposed costæ are also visible; concentric lines of growth distinctly marked. Structure unpunctuated; length 7, width $7\frac{1}{2}$, depth 5 lines.

Obs. This little species was discovered in the Upper Lias of Ilminster, where it is common, by Mr. Moore; it has likewise been met with in beds of the same age, by Mr. H. Miller, at Cromarty, in Scotland, and is quite distinct from all the species of *Rhynchonella*, yet discovered in the Oolitic Period, and cannot be mistaken for *R. variabilis*, with which it differs completely; in some rare instances, instead of two or three plaits on the mesial fold, I have found four and even five; but this kind of variation is common to all *Rhynchonellæ*, and therefore cannot be taken into consideration. It gives me great pleasure to name it after my valued friend, M. Bouchard.

Figs. 3 and 4, represent two examples from the Upper Lias of Ilminster, in the collection of Mr. Moore.

Fig. 5. A specimen from Cromarty, in the collection of Mr. Miller.

77. RHYNCHONELLA VARIANS, *Schloth.*, Sp. Plate XVII, figs. 15, 16.

- TEREBRATULITES VARIANS, *Schlotheim*. 1820. *Die Petrefactenkunde*, p. 267; *Ency. Meth.*, pl. 241, fig. 5^{a b}.
- OBTRITA, *Defrance*. 1828. *Dic. d'Hist. Nat.*, vol. liii, p. 161; *Ency. Meth.*, pl. 241, fig. 5.
- VARIANS, *Ræmer*. 1835. *Die Vers. des Nord. Oolithen gebirges*, tab. ii, fig. 12.
- SOCIALIS, *Phillips*. 1835. *Illust. of the Geol. of York.*, part i, p. 135, pl. vi, fig. 8.
- VARIANS, *Deshayes*. 1836. *Nouv. Ed. de Lamarck*, p. 352.
- — *Von Buch*. 1834. *Über Terebrateln*; and 1838, *Mém. Soc. Géol. de France*, vol. iii, p. 135, pl. xiv, fig. 4.
- — *Pusch*. *Polens Palæont.*, 1837, p. 12, pl. iii, fig. 3.
- — *Bronn*. *Lethæa Geog.*, 1837, pl. xviii, fig. 4, and *Index Pal.*, 1848, p. 1254.
- SOCIALIS, *Morris*. *Catalogue*, 1843.
- VARIANS, *D'Orb.* in *Murch. Russia*, vol. ii, p. 480, pl. xlii, figs. 14, 17, 1845.
- RHYNCHONELLA VARIANS, *D'Orb.* *Prodrome*, vol. i, p. 376, 1849.

Diagnosis. Shell inequivalved, somewhat irregularly triangular, of the size of a hazel

nut, wider than long; valves convex; beak acute, small, more or less recurved; foramen circular, always lying close to the umbo, being entirely or partially surrounded by the deltidial plates, a small portion of the circumference being completed by the umbo, a flatness or false area existing between the beak ridges and the hinge margin, which last does not much indent the smaller valve. Surface ornamented by a variable number of small plaits, about twenty-four on each valve, from five to six, or seven, rarely three, forming an elevated mesial fold, the smaller valve arising from the umbo, by a gentle curve to about half its length, when the inclination becomes more rapid as it approaches the extremity of the valve where it is suddenly bent downwards to meet a well-defined and deep sinus; the plaits in the sinus seems, as if longitudinally depressed or split in their centre, as they approach the front margin. Structure imperforated; length 8, width $7\frac{1}{2}$, depth 5 lines.

Obs. This variable shell received, in 1820, from Schlotheim, the name of *varians*, that author referring to the very indifferent figure in the 'Ency. Meth.' unnoticed by Sowerby, it was subsequently figured by Professor Phillips, under the name of *Ter. socialis*, which name has been admitted by Mr. Morris and Prof. Bronn to be a synonym, of which I convinced myself by comparing the Professor's shell kindly lent me by Mr. Bean, with the German types. It was well described by Baron Von Buch, who states it to occur by millions where it is found. In England, it is abundant in the *Fuller's Earth* round Bath, also at Scarborough and Hackness, and in the Kelloway Rock of Kelloway, from which locality I am indebted to Mr. Walton for many examples. On the Continent, it is stated by Von Buch to occur in the upper portions of the Middle Jura, it is rarely wanting in the bed approximating to the Upper Jura, at Beggingen and at Osterfingen, in the canton of Schaffouse, at Fürstenberg, near Bahlingen, in the Wurtemberg, near Doneschingen, near Amberg, &c.

The Terebratula figured by Zieten, under the name of *Ter. varians*, does not belong to the species, as correctly remarked by M. D'Orbigny; it more resembles *R. cynocephala*, (Rich.); *R. varians* of Schlotheim, is placed by M. D'Orbigny in his (*Ter. Oæfordien.*)

Figs. 15, 16. Two specimens, nat. size.

Fig. 15^{b c d}. Enlarged illustrations.

78. RHYNCHONELLA FORBESII, *Dav.* Plate XVII, fig. 19.

Diagnosis. Shell inequivalve, globular, and circular, beak small, recurved, foramen entirely surrounded by the deltidium; hinge margin of larger valve not much indenting that of the smaller; surface ornamented by about twenty small plaits on each valve, five or six of which form a raised mesial fold not projecting distinctly above the lateral plaits: the sinus is very shallow. Length 4, breadth $3\frac{1}{2}$, depth 3 lines.

Obs. Thirteen specimens of this small species have been obtained in the Inferior Oolite of Somersetshire, by the officers of the Geological Survey, and now deposited in their Museum; as remarked by Professor Forbes, all the examples are so similar and constant in shape, that it is not very probable that they are young individuals, as we do not find any other similarly plaited globular Rhynchonella in our Oolites, to which we could refer it; it somewhat resembles *R. Pisum*, but can be distinguished without difficulty from the Cretaceous species, which is a flatter and more delicately plaited shell.

Fig. 19. Natural size, from a specimen in the collection of the Geological Survey.

„ 19^{a b c}. Enlarged illustrations.

79. RHYNCHONELLA SERRATA, *Sow.* Sp. Plate XV, figs. 1, 2.

TEREBRATULA SERRATA, *Sow.* M. C., vol. v, 1825, p. 168, tab. 503, fig. 2.

— — *Morris.* Catalogue, 1843.

— — *Tennant*, 1847. A Strat. List of British Fossils, p. 74.

— — *Bronn.* Index Palæont., 1848, p. 1250.

RHYNCHONELLA SERRATA, *D'Orb.* 1849. Prodrome, vol. i, p. 289.

Diagnosis. Shell irregularly subtrigonal, generally a little wider than long, valve almost equally convex, but depressed; beak small, much recurved, and lying over the umbo, leaving little space for the passage of the pedicle muscular fibres; beak ridges well defined, exposing a slightly concave false area between them and the hinge margin, a similar depression being likewise visible on either side of the umbo, the hinge line not much indenting that of the smaller valve. Surface ornamented by a variable number of large sharp plaits, proceeding from the beak and umbo to the front and sides, from fourteen to fifteen on either valve, generally no distinct mesial fold or sinus; six or seven plaits are sometimes a little raised in front in the smaller valve; structure imperforated. Length 15, width 17, depth 10 lines.

Obs. This beautiful species was well described and figured by Sowerby from a small specimen stated to have been found in the Lias of Lyme-Regis, whence, however, I have never obtained an example, and I believe it probable that Sowerby's type was found in the Marlstone of Ilminster, whence many fine specimens have been obtained by Mr. Moore. Sowerby alludes to the shell in the 'Ency. Meth.,' (Pl. 243, fig. 11, and Pl. 244, fig. 1,) as being possibly referable to the species under consideration. We do not, however, believe them identical, although allied; the shell of the 'Ency.' is *Terebratula plicata* of Lamarck, which is a *Rhynchonella*,¹ and seems distinguished from *R. serrata* by being less depressed, deeper, longer than wide, and ornamented by fewer costæ, seven or eight on each valve; some specimens presenting four plaits, others five on the mesial fold, and in a few, two uniting into one towards the margin of the shell; characters different from

¹ Lamarck, 'An. sans Vert.,' vol. vi, 1819, No. 39; and Dav. on Lamarck's species, 'Annals and Mag. of Nat. Hist.,' vol. ii, 2d ser., June, 1850, Pl. xiv, fig. 39.

what we observe in *R. serrata*. I am not acquainted with any specimens exactly similar to our English type from the Continent, although I found in the Lias of Fontaine-Etoupefour, in Normandy, some examples approaching to *R. serrata*, and of which they may perhaps be a variety.

Plate XV, fig. 1. From a specimen in the collection of Mr. Moore.

„ fig. 2. An elongated variety from my collection.

80. *RHYNCHONELLA PLICATELLA*, Sow. Sp. Plate XVI, figs. 7, 8.

TEREBRATULA PLICATELLA, Sow. 1825. Min. Con., vol. v, p. 167, tab. 503, fig. 1.

— — *Von Buch*, 1834. *Über Terebrateln*; et *Mém. de la Soc. Géol. de France*, 1838, vol. iii, 1st ser., p. 146, pl. xv, fig. 17.

— — *Deshayes*, 1836. *Nouv. Ed. de Lamarck*, p. 355.

— — *Deslongchamps*, 1837. *Soc. Linn. de Normandie*.

— — *Morris*. Catalogue, 1843.

— — *Tennant*. A Stratigraphical List of Brit. Fossils, 1847, p. 74.

— — *Bronn*. Index Palæont., 1848, p. 1246.

RHYNCHONELLA PLICATELLA, *D'Orbigny*, 1849. *Prodrome*, vol. i, p. 286.

Diagnosis. Shell inequivalve, subtrigonal, sub-globose, longer than wide; perforated valve, shallow and depressed, less convex than the other; front semicircular, beak acute, not much produced, tapering, more or less recurved; foramen small, entirely surrounded by the deltidial plates; beak ridges sharply defined; a slightly concave false area existing between them and the hinge margin, a similar depression being likewise visible on either side of the umbo, giving to this portion a pinched appearance; the hinge-line greatly indenting the imperforated valve, which is regularly convex, and nearly three times as deep as the rostral one; surface ornamented by a variable number of plaits, from twenty-six to fifty on either valve; rarely any distinct mesial fold or sinus. Some of the costæ bifurcate at a short distance from the beak and umbo; structure imperforated. Length 18, breadth 17, depth 13 lines. Some examples attain even larger dimensions.

Obs. This species belongs to the Inferior Oolite of Chideock, near Bridport, whence the original specimen figured and described by Sowerby was obtained by Sir H. de la Beche, and is now deposited in the Museum of the Geological Society; since that period it has been found in several other localities, such as at Dundry and Dinnington. On the Continent very fine specimens are found at Moutiers, Bayeux, and other places in France; it was erroneously considered by DeFrance¹ to be the same as *Ter. multicarinata*, Lamarck, which is quite another species.² *R. plicatella* is well characterised, and does not seem to vary in general as much as some others, although, in its details, it is often very different, from the variable number of its plaits, and in the young state it is very much elongated, as

¹ *Die. Hist. Nat.*, vol. liii, 1828, p. 137.

² Davidson's Notes on an Examination of Lamarck's Species of Fossil Terebratulæ. 'An. and Mag. of Nat. Hist.', vol. v, 2d ser., 1850, Pl. xiv, fig. 37.

in fig. 8, and is specially remarkable from the convexity of the imperforated valve, which in this case is by far the largest of the two. On some internal casts I have observed the almost entire vascular system, the principal arteries becoming more and more subdivided as they approach the margin of the shell or mantle. The beak is also, in some few instances, and more commonly so in British specimens, much recurved, leaving little space for the passage of the pedicle fibres; but this is not the case with the generality of specimens where the foramen is completely exposed, and more or less separated from the umbo by the deltidial plates. Fig. 8 is drawn from a specimen in the collection of Dr. Wright.

81. RHYNCHONELLA INCONSTANS, Sow. Sp. Plate XVIII, figs. 1, 2, 3, 4.

- TEREBRATULA INCONSTANS, Sow. M. C., vol. iii, p. 137, tab. 277, figs. 3, 4, 1821.
 — — V. Buch, 1834. Über Terebrateln; and 1838, Mém. de la
 Soc. Géol. de France, vol. iii, p. 146, pl. xiv, fig. 16.
 — — Deshayes, 1836. Nouv. ed. de Lamarck, p. 355.
 — — Pusch? 1837. Polens Pal., pl. iii, fig. 3.
 — — Deslongchamps, 1837. Soc. Linn. de Normandie.
 — DIFFORMIS, Zieten, 1832. Die Vers. Wurt., tab. xlii, fig. 2. (Non
 T. difformis,) Lamarck.
 — INCONSTANS, Morris. Catalogue, 1843.
 — — Tennant. A Strat. List of British Fossils, p. 73, 1847.
 RHYNCHONELLA INCONSTANS, D'Orbigny, 1849. Prodrome, vol. i, p. 375.

Diagnosis. Shell almost circular, more or less globose, unsymmetrical, rather wider than long; beak acute and recurved, under which is seen a small foramen entirely surrounded by the deltidium, and more or less separated from the umbo. Lateral ridges well defined, leaving between them and the hinge margin a flat or concave false area, which slightly indents the smaller valve. Valves convex, generally gibbous, without mesial fold or sinus, one half at a little distance from the beak and umbo, becoming more elevated than the other, which is turned down as if twisted, separating the shell into two parts; in some specimens the elevation is at the right, in others at the left side of the shell. Surface ornamented by a variable number of simple plaits, from thirty to forty on each valve. Length 19, width 22, depth 18 lines.

Obs. *R. inconstans* seems to have been first figured by W. Smith, in or after 1816,¹ from the Kimmeridge Clay. It was shortly afterwards named, figured, and described, by Mr. Sowerby, under the above-mentioned denomination, that author observing, "that one half of the edge is turned up and the other down, but indifferently to the right or left." Professor Phillips² and Mr. Morris³ mention it as found in the Speeton Clay of Yorkshire, but I believe this to be a mistake; the Speeton Clay being considered

¹ Strata identified by organised fossils, pl. x, fig. 6.

² Illustrations of the Geology of Yorkshire, 1831.

³ Catalogue, 1843.

Cretaceous, where the species has not hitherto with certainty been found. It made its first appearance in the Inferior Oolite, specimens from Leckhampton Hill, near Cheltenham, being undistinguishable from many of those so abundantly found in the Oxford Clay of Wooton Bassett, and Shotover Hill, near Oxford, as well as with some derived from the Kimmeridge Clay of Weymouth.

I am not prepared to admit, with Professor Bronn,¹ that Sowerby's species is a synonym of that described by Lamarck in 1819, under the appellation of *Ter. difformis*; it is certain that the last-named author's type was taken from a shell found in the Cretaceous or Tourtia beds of Tournay, in Belgium;² those figured in the 'Ency. Meth.', Pl. 242, fig. 5, *a b c*, being likewise from the Cretaceous beds of France, as justly observed by M. D'Orbigny.³

There exists certainly much general similarity between *some* specimens of *R. difformis* and *R. inconstans*; but when adult and well characterised, the last seems easily distinguished by its more circular form, greater convexity, and stronger plaits; the Cretaceous species being more delicate in general appearance, not so convex, much wider than long, its plaits smaller, and its foramen larger and tubular. As justly observed by Baron von Buch, the plaits in the *R. inconstans* are always simple, and do not bifurcate. It is found also in various parts of the continent, as in Normandy, near Namers, Ellrichserbring in Brunswick, Allem, and in other parts of Germany.

Plate XVIII, fig. 1. The largest specimen I have noticed, in the collection of the British Museum, from the Oxford clay of Wooton Bassett.

„ figs. 2, 3. Two specimens from the Kimmeridge clay of Weymouth, in the collection of Mr. Bowerbank.

„ fig. 4. From the Inferior Oolite of Leckhampton Hill, in the collection of Dr. Wright.

82. RHYNCHONELLA CONCINNA, Sow. Sp. Plate XVII, figs. 6—12.

TEREBRATULA CONCINNA, Sow. Min. Con., vol. i, 1812, p. 192, tab. lxxxiii, fig. 6.

— ROSTRATA, Sow. Ibid., vol. vi, 1829, p. 67, tab. 536, fig. 1, (not Cretaceous.)

FLABELLULA, Sow. Ibid., vol. vi, 1829, p. 67, pl. lxvii, pl. 535, fig. 1.

— CONCINNA, V. Buch. Über Terebrateln, 1834; and Mém. Soc. Géol. de France, vol. iii, 1838, p. 144, pl. xiv, fig. 14, et *T. rostrata*, Mém. Soc. Géol. de Fr., vol. iii, p. 155, pl. xv, fig. 27.

— — Morris. Catalogue, 1843.

¹ Index Pal., pp. 1235 and 1238.

² Dav., Notes on an Examination of Lamarck's Species of Fossil Terebratula. 'Annals and Mag. of Nat. Hist.,' June, 1850.

³ Palæontologie Française, Ter. Crétacées, vol. iv, p. 41.

TEREBRATULA CONCINNA, *Tennant*, 1847. A Strat. List of British Fossils, p. 73.

— — *Bronn*, 1848. Index Palæont., p. 1233.

RHYNCHONELLA CONCINNA, *D'Orb.* Prodrome, vol. i, p. 315, 1849.

Diagnosis. Shell inequivalved, when adult nearly gibbose, more or less compressed, in the young; rather wider than long, beak acute and slightly recurved, foramen not entirely surrounded by the deltidial plates; a small portion being completed by the umbo, especially so when young, and up to a certain age in the adult state; the two plates sometimes meeting at the umbo. Beak ridges well defined, leaving between them and the hinge-line a false area, not much indenting the smaller one; surface ornamented by a variable number of acute plaits, about thirty-two in each valve, seven to eight of which forming a slightly elevated mesial fold, corresponding to a sinus in larger valve; structure imperforated. Length 11, width 12, depth 10 lines.

Obs. This is one of the oldest described species in the 'Min. Con.,' it is abundant in the Great Oolite of many localities in England, and is found at Hampton Cliff, Aynhoe, near Bath, Cirencester, &c. At Bradford it is found in the Bradford clay, and is one of our most common British and foreign species.

R. concinna is flat and compressed, when young, with hardly any visible mesial fold, (*T. flabellula*, Sowerby,) becoming convex and gibbose with age. *Ter. rostrata*¹ of that author, belongs likewise to this species, and is only a specimen where the beak is unusually elongated, of which any one will be convinced on inspecting the original specimens in the collection of Mr. J. de C. Sowerby; nor is it a Cretaceous shell, as stated by that author. M. D'Orbigny² is mistaken when mentioning *Ter. obsoleta*, Sowerby, as only a young state of *concinna*, an error at once evident from the last being a much smaller shell, and is distinguished from *obsoleta* by several characters alluded to under the head of that species.³

Plate XVII, fig. 6, illustrates an adult example from Cirencester.

- „ figs. 7, 8. Middle aged specimens, likewise from Cirencester.⁴
- „ figs. 9, 10. Young individuals, *Ter. flabellula*, of Mr. Sowerby.
- „ fig. 11. An exceptional specimen, *T. rostrata*, of Sowerby.
- „ fig. 12. An enlarged illustration of the beak and foramen.

¹ In Mr. Sowerby's figure, the foramen is incorrectly placed.

² Prodrome, vol. i, p. 315.

³ In a paper lately published, (Mém. de la Soc. Géol. de France, vol. iv, 2d ser., p. 28, pl. viii, figs. 10, 11, 1851,) Mr. Bayle describes and figures as *T. concinna*, Sowerby, a shell which does not seem to me to belong to that species, but more like *R. lacunosa*, Schlotheim, nor does the figure 10 of the same author appear referable to *R. lacunosa*.

⁴ The recent *Rh. nigricans*, Sow., Zool. Proc., 1846, is undistinguishable from half grown *R. concinna*, Sow., the former of which was dredged by Mr. Evans, R.N., in 19 fathoms, Foveaux Strait, New Zealand, about five miles north-east of Ruapuke Island, examples of which may be seen in the collections of Messrs. Evans, Cuming, and the British Museum, but probably never becomes as globular, as that species is found, when adult.

83. *RHYNCHONELLA SUBCONCINNA*, *Dav.* Plate XVII, fig. 17.

Diagnosis. Shell more or less triangular, depressed, rather longer than wide; valves almost equally convex; beak moderately produced, acute, nearly straight; foramen almost entirely surrounded by the deltidial plates, a small portion being completed by the umbo; beak ridges distinct, leaving a flat space between them and the hinge margin, which indents that of the smaller valve. Surface ornamented by a great number of small plaits from fifty to sixty on each valve; the mesial fold and sinus are hardly perceptible, and ornamented by from fourteen to fifteen plaits. Structure unpunctuated; length 7, width about 6, depth 3 lines.

Obs. This species was found by Mr. Moore in the Marlstone of Ilminster, and seems remarkable from the great number of minute striæ which ornament its surface. It approaches in shape to some young shells of *R. concinna*; but in these last, the costæ are less numerous and fine, nor does it ever appear to attain the same dimensions or character of adult specimens of *R. concinna*.

Fig. 17. From the collection of Mr. Moore.

84. *RHYNCHONELLA OBSOLETA*, *Sow.*, Sp. Plate XVII, figs. 1—5.

TEREBRATULA OBSOLETA, *Sow.* M. C., vol. i, 1812, p. 192, tab. lxxxiii, figs. 7, 8.

— — *Parkinson.* 1822. An Introduction to the Study of Organic Remains, p. 234.

— — *Schlotheim.* 1832. Syst. Vers. der Petrefacten.

— *CONCINNA*, *Bronn.* Leth. Geog., 1837, p. 289, pl. xviii, fig. 3, (non *concinna*, but *obsoleta*, *Sow.*)

— *OBSOLETA*, *Morris.* Catalogue, 1843.

— — *Tennant.* 1847. A Strat. List of British Fossils, p. 73.

Diagnosis. Shell circular, or irregularly oval, gibbous, longer than wide; beak acute, produced, not much recurved; foramen entirely surrounded by the deltidial plates, and more or less separated from the umbo; beak ridges distinct, leaving between them and the hinge line a false area which indents considerably the smaller valve. Surface ornamented by from twenty-two to thirty-three strong acute plaits, five to eight of these forming a slightly raised mesial fold with corresponding sinus in the other valve. Structure imperforated; length 19, width $17\frac{1}{2}$, depth 13 lines.

Obs. *R. obsoleta* was figured by Walcot, in 1799.¹ It occurs in the same localities and beds as *R. concinna*, and is common to the Great Oolite of Hampton Cliff, near Bath, Felmersham, Cirencester, &c., nor is it rare in the Bradford Clay of Bradford, where large specimens have been obtained, as may be seen from the fine series deposited in the

¹ Petrifications found near Bath.

Museum of the Geological Society. It is, likewise, probable that the vertical range of this species extended beyond the limits here traced: some specimens from the Cornbrash being undistinguishable from certain varieties of the shell under consideration.

On the Continent, it is abundantly distributed in the Great Oolite of Ranville, &c., in Normandy. From *R. concinna* it seems distinguished by its dimensions, larger, and deeper plaits; the deltidium surrounding and separating the foramen from the umbo, which character appears to have been noticed by Mr. Sowerby, since he gives a separate figure of this portion of the shell: the hinge margin indenting likewise more the smaller valve than in *concinna*, it therefore could not be a young state of this last-named shell, as erroneously supposed by M. D'Orbigny.¹ In the young state, both *R. concinna* and *obsoleta* are quite distinct; the last being more elongated and deeply plicated, while in *concinna* the shell is transversely compressed, and the plaits are smaller and more numerous. Professor Bronn² considers *R. obsoleta* a synonym of *R. tetraëdra*, but I believe the two species can be easily distinguished. Sowerby's figures both of *R. concinna* and *obsoleta* are very unfortunate, as well as those of *tetraëdra* and *media*, from the fore-shortened aspect selected for illustration.

Plate XVII, fig. 1. From the Bradford Clay, in the collection of the Geological Society, being the largest specimens I have seen of the species.

„ figs. 2, 3. Young shells, from Bradford.

„ fig. 4. Interior. Illustrating the two short shelly lamella *a*, to which were attached the free fleshy arms; *b*, are the muscular impressions.

„ fig. 5. The beak, foramen, and deltidium (enlarged).

85. RHYNCHONELLA SUBOBOSOLETA, *Dav.* Plate XVII, fig. 14.

Diagnosis. Shell inequivalved, circular, semi-globose, nearly as broad as long; beak moderately produced; foramen circular, entirely, or otherwise surrounded by the deltidial plates, a small portion being generally completed by the umbo; false area not very well defined, the hinge margin not much indenting the smaller valve. Surface ornamented by a variable number of large costæ, from nineteen to twenty-one or two on each valve; the mesial fold not much produced nor always distinct, formed of from four to six plaits; sinus shallow. Structure unpunctuated; length 12, width 12, depth 9 lines.

Obs. This shell is always much smaller than either *R. obsoleta* or *concinna*, rarely attaining the dimensions given above, it belongs to the middle division of the Inferior Oolite of Minchinhampton, according to Messrs. Lycett and Woodward. It possesses

¹ Prodrôme, vol. i, p. 315.

² Index Pal., pp. 1243 and 1253.

characters of both the above-mentioned species, it has the beak, foramen, and deltidium of *concinna*, but is distinguished from it by its plaits, which are fewer in number, much larger, and deeper; the valves are also nearly equally convex, which is not the character of the Sowerby types. I propose naming it *subobsoleta*, as it may, perhaps, be a variation of that form, although I have not found sufficient grounds to admit it to be such.

Fig. 14 illustrates the largest specimen I have seen, from the collection of the British Museum.

86. *RHYNCHONELLA ANGULATA*, Sow. Sp. Plate XVII, fig. 13.

TEREBRATULA ANGULATA, Sow. Min. Conch., vol. v, 1825, p. 166, tab. 502, fig. 4,
(placed there under the name of *acuta*, corrected afterwards to *angulata*.)

— — Morris. Catalogue, 1843.

— — Bronn. Index Pal., 1848, p. 1229.

RHYNCHONELLA ANGULATA, D'Orb. Prodrome, 1849, vol. i, p. 286.

Diagnosis. Shell transversely oblong, gibbose; beak moderately produced; foramen not entirely surrounded by the deltidium, a small portion being completed by the umbo; valves ornamented by a variable number of plaits, from ten to twenty-five on each; five or six forming a moderately produced mesial fold, with corresponding plaits in the sinus; length 7, width 9, depth 6 lines.

Obs. According to MM. D'Orbigny, Morris, Waterhouse, and other Palæontologists, this species is distinct from *R. concinna*; it is shorter, more transverse, than that shell, but I am not yet certain that it may not be a variety. Von Buch is, however, mistaken, in placing it as a synonym of *R. depressa*, Sow. *R. angulata* is found in the Inferior Oolite of Cleve Hill, near Cheltenham; the specimen figured in my plate is the original type kindly lent me by Mr. J. de C. Sowerby.

87. *RHYNCHONELLA MORIÈREI*, Dav. Plate XVIII, figs. 12, 13.

Diagnosis. Shell somewhat triangular, longer than wide; beak tapering to an acute point not much recurved, under which is seen a small foramen entirely surrounded by the deltidium, which separates it more or less from the umbo; beak ridges well defined, leaving between them and the margin a large flat, or slightly concave false area, which indents considerably by a marked curve the corresponding margin of the umbo. Valves moderately convex, ornamented by a variable number of plaits, from thirty-three to forty-four on each valve, from seven to nine composing a well-defined mesial fold, the lateral plaits proceed by a gentle curve downwards to the margin, giving the shell an elegant, somewhat winged aspect. The sinus is moderately deep, with from six to eight plaits. Length 17, width 15, depth 12 lines.

Obs. This elegant species was discovered by the Rev. A. W. Griesbach, in the Cornbrash of Rushden, in Northamptonshire, and has likewise been found in the same formation at Marquise, near Boulogne, by M. Bouchard. This form, although approaching to *R. obsoleta* in some respects, seems to me not to possess all the characters belonging to that species; it is more elegant and somewhat winged shape, smaller, has more delicate plaits, and its prominent mesial fold, as well as general aspect, appear to distinguish it from the types of *obsoleta*, as found in the Great Oolite and Bradford clay; if not specifically distinct, it would be at least a well-marked variety. After submitting the question to various competent persons whose opinions likewise differed, I have ventured to distinguish it by a separate appellation.

Plate XVIII, fig. 12. From a specimen from the Cornbrash of Rushden, in the collection of the British Museum.

„ fig. 13. From one in that of the Rev. A. W. Griesbach.

88. RHYNCHONELLA TETRAEDRA, Sow. Sp. Plate XVIII, figs. 5—10.

TEREBRATULA TETRAËDRA, Sow. M. C., vol. i, 1812, p. 191, tab. lxxxiii, fig. 5.

— — — *Parkinson.* An Introduction to the Study of Organic Remains, p. 227, 1822.

— MEDIA, Ib., p. 234.

— TETRAËDRA, *Defrance.* Dic. d'Hist. Nat., vol. liii, p. 158, 1828.

— — — *Young and Bird.* Geological Survey of the Yorkshire Coast, pl. viii, fig. 15, 1828.

— — — *V. Buch.* 1834. Uber Ter.; and Mém. de la Soc. Géol. de France, 1838, vol. iii, p. 139, pl. xiv, fig. 8.

— — — *Schlotheim.* 1832. Systematisches Vers der Petrefacten.

— — — *Deslongchamps.* Soc. Linn. de Normandie, 1837.

— — — *Morris.* Catalogue, 1843.

— — — *Tennant.* A Strat. List of British Fossils, p. 74, 1847.

TEREBRATULA TETRAËDRA, *Bronn.* Index Pal., p. 1253, 1848, (but not all his synonymys.)

RHYNCHONELLA TETRAËDRA, *D'Orbigny.* Prodrome, vol. i, p. 258, 1849.

Diagnosis. Shell variable in shape, obtusely deltoid, valves convex and gibbous, wider than long; beak acute, more or less recurved, almost touching the umbo in some species; foramen small, generally entirely surrounded by the deltidium; beak ridges well defined, leaving between them and the hinge margin a small concave false area, which indents more or less the umbo of smaller valve, which is likewise laterally depressed, as if pinched in. The greatest depth is, in some specimens, towards the middle, in others near the front. Surface ornamented by a variable number of sharp plaits, from twenty-two to thirty on each valve; varieties with four, five, six, seven, eight, and nine plaits, forming a central more or less elevated mesial fold, corresponding to three, four, five, six, seven plaits, in a deep sinus in larger valve: on either side of the mesial fold are seen one or two plaits, which

do not generally attain to the frontal margin, but disappear at a little distance from it, so that the lateral plaits of the mesial fold and the side plaits are often widely separated by a large flat space; sometimes the lateral costæ are observed to bifurcate.

Dimensions variable; the largest specimen I have seen, measured, length 15, width 21, depth 15 lines; but in general they do not exceed length 12, width 13, depth 13 lines.

Obs. *R. tetraëdra* is one of those perplexing species often difficult to determine, from the great variety it presents, owing to several causes, and especially to the variable number of plaits ornamenting its surface, and mesial fold, which sometimes is considerably produced above the sides of the valve, while in other cases very little difference of level is perceptible, the mesial fold, as well as sinus, being shallow. Mr. J. de C. Sowerby having kindly placed at my disposal for examination the original types of *T. tetraëdra* and *media*, with the assistance of Mr. Waterhouse, we came to the same conclusion, already arrived at by some authors (V. Buch,¹ Morris, Bronn, &c.), viz., that *T. media* of Sowerby is only a variety of *tetraëdra*. In true *media*, as seen by the profile view, Pl. XVIII, fig. 9, the larger valve is deeper in the middle, and the beak more recurved, touching the umbo; the shell being, in general, more globose than what we observe in the specimens of true *R. tetraëdra*, Sowerby, Plate XVIII, fig. 8; but, on the examination of a suite of specimens, we soon perceive that there is every degree of passage between the extreme states of the same species. I cannot, however, admit, with Professor Bronn,² that *T. obsoleta*, of Sowerby, is a synonym of *tetraëdra*; both forms seem to me sufficiently distinct to be retained as separate species. *R. obsoleta* is a much less convex, and rather compressed shell, the longitudinal curve of the valves being more uniformly regular; the beak not so recurved, always exhibiting under it the foramen, entirely surrounded by the deltidium, which is separated more or less from the umbo. The same author's other synonyms of the present species would likewise require further examination before being admitted, as there exists some doubts as to the true types of some of Zieten's forms, as well as Mr. Quenstedt's rectifications;³ indeed, I am sorry to find, that some German authors have added much to the confusion by attributing to the Sowerby types species widely separated both in form and stratigraphical position. Lamarck, as justly remarked by Baron V. Buch, confounded the species under consideration with Schlotheim's *R. decorata*.⁴ Kœnig committed the same error.⁵ *R. decorata* has not, to my knowledge, been found in the Lias or Cretaceous formations, as stated by the last-named author. W. Smith's figure of *T. media*⁶ seems more likely to be *R. varians* of Schlotheim.

¹ See for reference at the head of this description.

² Index Pal., p. 1258.

³ Das Flözgebirge Württembergs, 1843.

⁴ See Lamarck, 'An. Sans. Vert.,' vol. vi, 1819, and Von Buch, 'Mém. Soc. Géol. de France,' vol. iii, p. 146.

⁵ Icones Fossilium Sectiles, p. 3, pl. vi, fig. 72.

⁶ Strata identified by organised Fossils; London, June, 1816—27, pl. xix, figs. 1—3.

In England, *R. tetraëdra* is found in the Upper and Middle Lias or Marlstone of many localities; it abounds in the neighbourhood of Ilminster, where it attains very large dimensions, as may be remarked from the figures, Pl. XVIII, figs. 6 and 7. It is likewise plentiful, but smaller, in the Lias of Radstock, Deddington in Yorkshire, &c. Mr. Sowerby mentions Aynhoe and Banbury in Oxfordshire, Von Buch states the species to occur in the Inferior Oolite of Dundry,¹ whence, however, I have not seen any authenticated specimens. Mr. Morris² mentions it from the Inferior Oolite of Somerset, from the Kelloway Rock of Kelloway, and from the Fuller's Earth, Banbury; but in the multitude of specimens sent me from all those formations of the Oolitic period, I have never been so fortunate as to recognise any authentic specimen of the species, except one remarkable example, Pl. XVIII, fig. 10, sent me by Mr. Walton, and said to be from the Inferior Oolite of Leckhampton Hill, Cheltenham, which approaches likewise to some varieties of *R. decorata*. On the Continent the species is found in many localities; at Landes, Evreci, Fontaine-Etoupefour, &c., in Normandy, also in Germany.³

Plate XVIII, fig. 5. A type specimen, in the collection of Mr. J. de C. Sowerby.

„ figs. 6, 7. From specimens in the collection of Mr. Moore.

„ fig. 10. From the Inferior Oolite of Cheltenham, in the collection of Mr. Walton.

89. RHYNCHONELLA SUBTETRAËDRA, Dav. Plate XVI, figs. 9—12.

Diagnosis. Shell more or less transversely circular, generally wider than long; valves nearly equally convex, rarely gibbous, somewhat compressed; beak acute, moderately produced, and slightly recurved; foramen of moderate size, entirely surrounded by the deltidium; a narrow flat or slightly concave false area existing between the beak ridges and hinge margin which does not indent much the smaller valve. Surface ornamented by a variable number of acute plaits, from twenty to thirty on each valve; mesial fold more or less produced, composed of a variable number of plaits in general from five to nine; sinus shallow, dimensions variable; length of largest specimen 21, width 24, depth 14 lines.

Obs. On comparing the shells under notice with a number of known species, I have not been able to identify them with any of the described types; they vary from *concinna* and *obsoleta*, being much more transverse and strongly plaited; from *tetraëdra* they likewise differ sufficiently not to represent that type. With *lacunosa* they have some resemblance, but on comparing our form with that shell, I could not make up my mind to place them

¹ Mém. Soc. Géol. de France, vol. iii, p. 140.

² Catalogue of British Fossils, 1843.

³ Messrs. Bayle and Coquand, figure and describe a Rhynchonella from the Lias of Manflas, Chili, as belonging to *T. tetraëdra*, Mém. Soc. Géol. de France, vol. iv, 2de ser., p. 17, 1851; but I cannot recognise the true type of the Sowerby species in their figure.

there ; at one time, I thought they might belong to *T. helvetica*, Schloth., but that species is so badly characterised, as well as figured, that it would be unsafe to refer our shell to that form ; neither Schlotheim's nor Zieten's figure apparently possessing any definite mesial fold. I have, therefore, under these circumstances, given it a distinct appellation.

R. subtetraëdra is found in the Inferior Oolite of Dundry and Leckhampton Hill, near Cheltenham, where it has been collected by Mr. Walton and Dr. Wright.

Plate XVI, fig. 12. A variation with hardly any distinct mesial fold and few plaits, from the Inferior Oolite of Somersetshire, in the collection of the Geological Survey.

„ fig. 9. A large specimen from the Inferior Oolite, Dundry.

„ fig. 10. A specimen from Dundry, in the collection of Mr. Walton.

„ fig. 11. A variety from the Upper Ferruginous Bed of Leckhampton Hill, in the collection of Dr. Wright.

90. RHYNCHONELLA LACUNOSA, *Schloth.*, Sp. Plate XVI, figs. 13, 14.

TEREBRATULITES LACUNOSA, *Schlotheim*. 1813. Beiträge für Nat. Vers., in Leonhard's Min. Taschen., vol. vii, pl. i, fig. 2.

TEREBRATULA LACUNOSA, *V. Buch*. 1834. Über Ter.; and 1838, Mém. Soc. Géol. de France, vol. iii, first ser., p. 150, pl. xv, fig. 22.

— — *Bronn*. Index Pal., p. 1239, 1848.

RHYNCHONELLA LACUNOSA, *D'Orb*. Prodrome, vol. i, p. 375, 1849.

Diagnosis. Shell irregularly, transversely oval, wider than long ; beak acute, recurved ; foramen entirely surrounded by the deltidium, but lying close upon the umbo ; the false area between the beak ridges and hinge margin is well defined, a similar depression existing likewise on either side of the umbo ; valves unequally convex, and ornamented by a variable number of plaits, from eighteen to nineteen on each valve, four, five, or six forming a produced elevated mesial fold, to which corresponds a deep sinus in the other valve ; the convexity of the valve seems regular from the umbo to the front, the deepest portion of the shell being towards its centre ; length 12, width 13, depth 9 lines.

Obs. The specimens described above were obtained by Mr. Robertson, of Elgin, at Dunrobin, in Scotland, in beds referred to the Oxford Clay ; and on comparing the well-preserved specimens forwarded by that gentleman with Schlotheim's figures of *T. lacunosa*, (1813,) I am disposed to believe them referable to the same species, which is peculiar to the Upper Jura on the Continent, and placed by M. D'Orbigny both in his *Terrain Oxfordien* and *Callovien*. It is, however, no easy matter to come to a certain conclusion on several species of Rhynchonella, for two principal reasons, the first, arising from the extreme variability of the shells of some species of this genus, and especially on account of the insufficient manner in which most authors have determined, figured, or described their species. In the case before us, it would be a waste of time to attempt a

discussion of all the synonyms attributed to this form by Professor Bronn, and other authors, as so much uncertainty exists as to the types intended. Both Baron Von Buch and Professor Bronn seem disposed to admit *Anomia triloba lacunosa*, of Fabio Colonna,¹ to be the type of the species in dispute; I am not, however, able to decide the question: but I cannot admit, as stated by the celebrated author of the 'Uber Ter.,' that *R. lacunosa* is common to the Upper Jura and to the Magnesian or Permian Limestone of Humbleton, in Yorkshire; the last does not even belong to the same genus, and is the *Camerophoria multiplicata*, so ably described and figured by Professor King in his valuable 'Monograph of British Permian Fossils.'

The shell under consideration has been attributed to *R. tetraëdra*, var. *media*,² a species I do not know with certainty to occur higher up than the Lias; the convexity of the valves and form of the beaks in this last easily distinguish it from the shell under notice.

Figs. 13, 14. From specimens in the collection of Mr. Robertson.

90. RHYNCHONELLA HOPKINSI, M'Coy, MS. 1852.

Diagnosis. Shell inequivalve, subcuboidal, valves gibbous, generally longer than wide, sides tumid, nearly vertical, beak acute, incurved, under the extremity of which is seen a small foramen entirely surrounded by the deltidium, beak ridges well defined, leaving a large slightly concave false area between them and the hinge line, which indents the imperforated valve, giving to this portion of the shell a pinched aspect, smaller valve very gibbous, ornamented by a variable number of small acute plaits, from twenty-four to thirty in number, three, four, five, or six, forming a well-defined elevated mesial fold. In the dental valve a very shallow sinus is visible, becoming convex as it approaches and meets the mesial fold; a number of small lines of growth cover the surface; structure imperforated, dimensions variable. Length $10\frac{1}{2}$, width $9\frac{1}{2}$, depth 9 lines.

Obs. This elegant shell was noticed for the first time by Mr. Bouchard, who found it in the Great Oolite of Marquise, near Boulogne-sur-Mer, where it is common; but it was only on a late visit to the Cambridge Museum that I became acquainted with its existence as a British species from the Great Oolite of Minchinhampton, and named in that collection by Professor M'Coy. This species is easily distinguished from *R. tetraëdra*, to which it bears some resemblance, by its square shape and more circular beak.³

¹ De Purpura Romæ, 1616.

² Sir R. Murchison, 'Trans. Geol. Soc.,' vol. ii.

³ I regret that from all my plates being printed before I became acquainted with the existence of this species in England, it could not be illustrated; in the Appendix, at the conclusion of this work, it is my intention to figure those new species which may be discovered during the interval.

TABLE OF BRITISH LIASIC AND OOLITIC BRACHIOPODA.

PART III.

Order in which described.	Genus.	Species.	Author.	Date.	Reference to this Monograph. (Part III.)	Lower Lias.	Middle Lias.	Upper Lias.	Inferior Oolite.	Fullers' Earth.	Stonesfield Slate.	Great Oolite.	Brad. Clay & For. Marble.	Cornbrash.	Oxford Clay & Kel. Rock.	Cor. Rag and Cal. Grit.	Kimmeridge Clay.	Portland Stone and Sand.
1	Lingula	Beanii . . .	Phillips	1829	p. 8, pl. i, f. 1 . . .	..	*	*	*								
1 bis	„	ovalis ¹ . . .	Sow.	1812	pl. xviii, f. 14 . . .	..	..	..	..	..	..	..	..	..	*	..	*
2	Orbicula ²	Townshendi . . .	Forbes	1851	p. 9, pl. i, f. 2 . . .	..	*										
3	„	reflexa . . .	Sow.	1829	p. 10, pl. x, f. 8 . . .	..	*										
4	„	Humphresiana ³ . . .	Sow.	1829	p. 10, pl. i, f. 3 . . .	..	..	..	..	..	..	..	..	..	..	..	*
4 bis	„	latissima ⁴ . . .	Sow.	....	.. . . .	..	..	..	..	..	..	..	..	..	..	..	*
5	Crania	antiquior . . .	Jelly	1843	p. 11, pl. i, f. 4—8 . . .	..	..	..	..	..		*	
6	„	Moorei . . .	Dav.	1851	p. 12, pl. i, f. 9 . . .	..	..	*								
7	Thecidea	Moorei . . .	Dav.	1851	p. 13, pl. i, f. 10 . . .	..	*										
8	„	Bouchardii ⁵ . . .	Dav.	1851	p. 14, pl. i, f. 15, 16 . . .	..	*										
9	„	Dickinsonii . . .	Moore	1851	p. 14, pl. xiii, f. 19 . . .	..	..	..	*						
10	„	triangularis . . .	D'Orb.	1849	p. 14, pl. i, f. 11, 12 . . .	..	*	*	*								
11	„	rustica . . .	Moore	1851	p. 15, pl. i, f. 4 . . .	..	..	*								
12	Leptæna	Moorei . . .	Dav.	1847	p. 17, pl. i, f. 18 . . .	..	..	*								
13	„	Pearcei . . .	Dav.	1847	p. 17, pl. i, f. 19 . . .	..	..	*								
14	„	granulosa . . .	Dav.	1850	p. 18, pl. i, f. 20 . . .	..	..	*								
15	„	liasiana . . .	Bouch.	1847	p. 18, pl. i, f. 21 . . .	..	..	*								
16	„	Bouchardii . . .	Dav.	1847	p. 19, pl. i, f. 22 . . .	..	..	*								

¹ Since describing the *Lingulidæ* in Part III, p. 8, several specimens have been forwarded to me from the Oxford and Kimmeridge Clays, which have satisfied me, that *L. ovalis*, Sowerby, (M. C., vol. i, p. 56, pl. 19, fig. 4, 1812.) is in reality an Oolitic species, having been found by Mr. C. B. Rose, Mr. Middleton, and others, under the shape of impressions on grey or brown clay, in Norfolk and Suffolk; the species likewise occurs, with its shell preserved, in the Kim. Clay of Ely, where it has been collected by Mr. Carter. I have therefore figured this form in pl. xviii, fig. 4, and it may be described as follows. *Ling. ovalis*, Sow.—Shell oblong, oval, rather square at the beaks, anterior edge circular, slightly convex, rather depressed: surface ornamented by a number of concentric raised lines of growth, length 7, width $3\frac{1}{2}$ lines. *L. ovalis* seems much more regularly oval than *L. Beanii*. Another small lanceolate-shaped *Lingula* has been discovered by Mr. Walton, in the Oxford Clay of Christian Malford, measuring, length $3\frac{1}{2}$, width not quite 2 lines, which may, perhaps, be another species.

² In page 7, of this Monograph, I quoted Prof. Owen in relation of the animal to the shell in *Orbicula* and *Crania*, not having remarked that the Professor had subsequently reversed his opinions, in the French 'An. Sc. Nat.,' May, 1845. I am indebted to Dr. J. E. Gray, of the British Museum, for the opportunity of examining, along with Mr. Woodward, the animal of both *Orbicula* and *Crania*, and am now satisfied that the lower or attached valve to which the animal chiefly adheres, in both these genera, corresponds to the perforated valve of *Terebratula*, so that whilst *Crania* and *Orbicula* form no exception to the invariable rule that the shell of the Brachiopod is fixed by means of the ventral valve, they differ remarkably from the other genera, in having the oral arms fixed to the ventral or attached valve.

³ Many beautifully preserved shells of this species may be seen in the Cambridge Museum.

⁴ In blocks of Kimmeridge Clay at Packefield, in Suffolk, Sowerby found associated with *L. ovalis* compressed impressions, which he describes and figures, 'M. C.,' tab. 139, figs. 1 and 5, under the name of *Patella latissima*; but these impressions have much more the aspect of an *Orbicula* than a *Patella*. Sowerby describes them as follows: "Shell nearly orbicular, flat, smooth; shell very thin, concentrically undulated; the umbo is excentric, the margins forming a very short oval." Unfortunately, I have not been able to procure any example preserving the shell, so that its structure could not be examined. Mr. Woodward showed me impressions of the same species, almost circular, on slabs of Kim. Clay from Braunston, Northampton, found by Miss Baker, and now in the British Museum. A large impression, forwarded to me by Mr. C. B. Rose, measured 21 lines in length and $16\frac{1}{2}$ in breadth; but, in general, the dimensions are much smaller, not exceeding 10 lines in length.

⁵ Since describing this species, in page 14, Mr. Moore has discovered a very large adult specimen of *Thecidea Bouchardii*, which, I find, measures, length 3 lines, width 4, and is the largest liasic *Thecidea* as yet obtained. The same species, with almost similar dimensions, has been discovered by Mr. Tesson, in the lias of Fontaine-Etoupefour, near Caen. (See Dav., 'An. and Mag. of Nat. Hist.,' April, 1852.)

Order in which described.	Genus.	Species.	Author.	Date.	Reference to this Monograph. (Part III.)	Lower Lias.	Middle Lias.	Upper Lias.	Inferior Oolite.	Fullers' Earth.	Stonesfield Slate.	Great Oolite.	Brad. Clay & For. Marble.	Cornbrash.	Oxford Clay & Kel. Rock.	Cor. Rag and Cal. Grit.	Kimmeridge Clay.	Portland Stone and Sand.
17	<i>Spirifer</i>	<i>rostratus</i> ¹	Schl.	1813	p. 20, pl. ii, f. 1—12, pl. iii, f. 1	*	*	*										
18	"	<i>Ilminsteriensis</i>	Dav.	1851	p. 24, pl. iii, f. 7			*										
19	"	<i>Walcotti</i> ²	Sow.	1823	p. 25, pl. iii, f. 2, 3	*												
20	"	<i>Munsterii</i>	Dav.	1851	p. 26, pl. iii, f. 4—6		*											
21	<i>Terebratulna</i>	<i>quadrifida</i>	Lamarck	1819	p. 28, pl. iii, f. 8—10		*											
22	"	<i>cornuta</i>	Sow.	1825	p. 29, pl. iii, f. 11—18		*											
23	"	<i>Edwardsii</i>	Dav.	1851	p. 30, pl. vi, f. 11—13, 15?		*											
24	"	<i>Waterhousii</i>	Dav.	1851	p. 31, pl. v, f. 12, 13		*											
25	"	<i>resupinata</i> ³	Sow.	1818	p. 31, pl. iv, f. 1—5		*											
26	"	<i>Moorei</i>	Dav.	1851	p. 33, pl. iv, f. 6, 7		*											
27	"	<i>impressa</i>	V. Buch	1832	p. 33, pl. iv, f. 8—10, pl. x, f. 7				*?						*			
28	"	<i>carinata</i>	Lamarck	1829	p. 35, pl. iv, f. 11—17				*									
29	"	<i>emarginata</i>	Sow.	1825	p. 35, pl. iv, f. 18—21				*									
30	"	<i>Waltoni</i>	Dav.	1851	p. 36, pl. v, f. 1, 6				*									
31	"	<i>numismalis</i>	Lamarck	1819	p. 36, pl. v, f. 4—9		*											
32	"	<i>Bakeriæ</i>	Dav.	1851	p. 38, pl. v, f. 11				*									
33	"	<i>digona</i> ⁴	Sow.	1812	p. 38, pl. v, f. 18, 24							*						
34	"	<i>obovata</i>	Sow.	1812	p. 39, pl. v, f. 14—17									*				
35	"	<i>ornithocephala</i> ⁴	Sow.	1812	p. 40, pl. vii, f. 6—13, 23					*			*	*	*	*		
36	"	<i>lagenalis</i>	Schloth.	1820	p. 42, pl. vii, f. 1—4									*				
37	"	<i>sublagenalis</i>	Dav.	1851	p. 42, pl. vii, f. 14									*				
38	"	<i>cardium</i>	Lamarck	1819	p. 43, pl. xii, f. 13—15							*						
39	"	<i>Buckmanii</i>	Dav.	1851	p. 44, pl. vii, f. 15, 16				*									
40	"	<i>Lycettii</i>	Dav.	1851	p. 44, pl. vii, f. 17—22			*										
41	"	<i>punctata</i>	Sow.	1812	p. 45, pl. vi, f. 1—6		*											
42	"	<i>subpunctata</i>	Dav.	1851	p. 46, pl. vi, f. 10—12, 16?		*											
43	"	<i>indentata</i>	Sow.	1825	p. 46, pl. v, f. 25, 26		*											
44	"	<i>insignis</i>	Schüb.	1832	p. 47, pl. xiii, f. 1										*	*		
45	"	<i>simplex</i>	Buck.	1845	p. 48, pl. viii, f. 1, 3				*									
46	"	<i>ovoides</i>	Sow.	1812	p. 48, pl. viii, f. 4—9				*									
47	"	<i>maxillata</i> ⁴	Sow.	1825	p. 50, pl. ix, f. 1—9							*	*					
48	"	<i>var. submaxillata</i>	Dav.	1851	p. 51, pl. ix, f. 10—12				*									
49	"	<i>perovalis</i>	Sow.	1825	p. 51, pl. x, f. 1, 6				*									
	"	<i>intermedia</i>	Sow.	1812	p. 52, pl. xi, f. 1—5									*				

¹ TORRUBIA, in his 'Hist. Nat. Hispanica,' tab. vii, fig. 6, 1773, gives two illustrations of this species, but without name. KNORR, in 1755, 'Lapides Diluv.,' Tab. B. iv, fig. 3, likewise figures this shell, but also without name. In 1813, SCHLOTHEIM named it *Terebratulites rostratus*, and refers to Knorr's figure. See 'Beit. Zur. Nat. der Vers.,' in Leonhard's 'Min. Tasch.,' vol. vii. It is also figured by SCHMIDT, 'Petref. Buch.,' pl. xxiii, fig. 6, 1846, under the name of *Sp. verrucosa*.

² WALCOTT, in 1799, Petrefactions found near Bath, gives an excellent figure of this species, but without name. FISCHER DE WALDHEIM figured this shell in 1809, in his 'Notice des Fossiles du Gour. de Moscou,' pl. i, figs. 10, 11, under the name of *Terebratula octo-plicata*, and later, in 1830—37, 'Ortyctographie du Gour. de Moscou,' under that of *Choristite Walcottii*, p. 141, pl. xxii, fig. 4. The figures in both works are very bad. SCHMIDT has also figured it in 1846, 'Petref. Buch.,' pl. xxiii, fig. 1.

³ *T. resupinata* was figured in 1773, by Torruba, 'Hist. Nat. Hisp.,' tab. ix, fig. 3. In the same work the author figures *T. buttala*, tab. ix, fig. 4, and *R. tetraëdra*, pl. i, figs. 1, 2, but without name. *T. resupinata* is likewise figured by SCHMIDT, 'Pet. Buch.,' 1846, pl. xli, fig. 3. Walcott, in 1799, gave good illustrations of *T. ornithocephala*, *T. digona*, *T. cardium*, *Rh. spinosa*, and *R. obsoleta*, but without names. In the work of SCHEUCHZER, 'Helvetiæ Hist. Nat. des Surw.,' 1752, several Oolitic species are figured, but so incorrectly, as to be of no possible use, and I only mention it here on account of its having been often referred to by SCHLOTHEIM. In MORTON's 'Nat. Hist. of Northamptonshire,' 1712, we find figures of *T. intermedia*, *ornithocephala*, *resupinata*, and *obovata*: some other illustrations are given, but they are not well defined.

⁴ *Ter. digona*, *T. ornithocephala*, and *F. maxillata*, were figured by LHWYD, 1699, but not named, 'Lithophylaci Britannici Ichnographia,' pl. x, figs. 830, 873, and pl. xi, fig. 890; the last is *T. maxillata*, and that author gives 19 figures of all ages. Lister, in 1688, 'Historia sive Synopsis Method. Conchyliarum,' tab. 456, fig. 16, gives an illustration of *T. digona*; few, however of the figures of that author can be recognised.

Order in which described.	Genus.	Species.	Author.	Date.	Reference to this Monograph. (Part III.)	Lower Lias.	Middle Lias.	Upper Lias.	Inferior Oolite.	Fullers' Earth.	Stonesfield Slate.	Great Oolite.	Brad. Clay & For. Marble.	Cornbrash.	Oxford Clay & Kel. Rock.	Cor. Rag and Cal. Grit.	Kimmeridge Clay.	Portland Stone and Sand.
50	<i>Terebratula</i>	<i>Phillipsii</i>	Morris	1847	p. 53, pl. xi, f. 6—8				*									
51	"	<i>globata</i>	Sow.	1825	p. 54, pl. xiii, f. 2—7				*									
52	"	<i>bucculenta</i>	Sow.	1825	p. 55, pl. xiii, f. 8				*						*	*		
53	"	<i>sphæroidalis</i>	Sow.	1825	p. 56, pl. xi, f. 9, 19				*									
54	"	<i>globulina</i>	Dav.	1851	p. 57, pl. xi, f. 20, 21				*									
55	"	<i>pygmea</i>	Morris	1847	p. 57, pl. xiii, f. 16			*										
56	"	<i>Bentleyi</i>	Morris	1851	p. 58, pl. xiii, f. 9—11				*					*				
56 bis	"	<i>sub-Bentleyi</i> ¹	Dav.	1851	p. 59, pl. xiii, f. 11				*					*				
57	"	<i>coarctata</i> ²	Park.	1811	p. 59, pl. xii, f. 12, 15				*			*	*	*	*			
58	"	<i>plicata</i>	Buch	1845	p. 60, pl. xii, f. 1—5				*			*	*	*	*			
59	"	<i>fimbria</i>	Sow.	1823	p. 61, pl. xii, f. 6—12				*			*	*	*	*			
60	"	<i>flabellum</i>	Def.	1828	p. 62, pl. xii, f. 19, 20				*			*	*	*	*			
61	<i>Terebratella</i>	<i>hemispherica</i>	Sow.	1829	p. 64, pl. xiii, f. 17, 18				*			*	*	*	*			
62	<i>Rhynchonella</i>	<i>Wrightii</i>	Dav.	1852	p. 69, pl. xiv, f. 1				*			*	*	*	*			
63	"	<i>furcillata</i>	Theodori	1834	p. 69, pl. xiv, f. 2—5		*		*			*	*	*	*			
64	"	<i>rimosa</i>	V. Buch	1831	p. 70, pl. xiv, f. 6		*		*			*	*	*	*			
65	"	<i>spinosa</i>	Schl.	1813	p. 71, pl. xv, f. 15, 20				*			*	*	*	*			
66	"	<i>senticosa</i>	Buch	1834	p. 73, pl. xv, f. 21				*			*	*	*	*			
67	"	<i>ringens</i>	Herauld	1834	p. 74, pl. xiv, f. 13—16				*			*	*	*	*			
68	"	<i>subringens</i>	Dav.	1852	p. 75, pl. xiv, f. 17				*			*	*	*	*			
69	"	<i>acuta</i>	Sow.	1818	p. 76, pl. xiv, f. 8, 9		*		*			*	*	*	*			
70	"	<i>cynocephala</i>	Rich	1840	p. 77, pl. xiv, f. 10—12				*			*	*	*	*			
71	"	<i>variabilis</i>	Schl.	1813	p. 78, pl. xv, f. 8—10; pl. xvi, 1—6		*	*	*			*	*	*	*			
72	"	<i>subvariabilis</i>	Dav.	1852	p. 80, pl. xv, f. 7; pl. xviii, f. 11				*			*	*	*	*		*	
73	"	<i>Lycettii</i>	Dav.	1852	p. 81, pl. xv, f. 6				*			*	*	*	*			
74	"	<i>oolitica</i>	Dav.	1852	p. 81, pl. xiv, f. 7				*			*	*	*	*			
75	"	<i>Moorei</i>	Dav.	1852	p. 82, pl. xv, f. 11—14				*			*	*	*	*			
76	"	<i>Bouchardii</i>	Dav.	1852	p. 82, pl. xv, f. 3—5			*	*			*	*	*	*			
77	"	<i>varians</i>	Schl.	1820	p. 83, pl. xvii, f. 15, 16				*			*	*	*	*			
78	"	<i>Forbesii</i>	Dav.	1852	p. 84, pl. xvii, f. 19				*			*	*	*	*			
79	"	<i>serrata</i>	Sow.	1825	p. 85, pl. xv, f. 1, 2		*		*			*	*	*	*			
80	"	<i>plicatella</i>	Sow.	1825	p. 86, pl. xvi, f. 7, 8				*			*	*	*	*			
81	"	<i>inconstans</i>	Sow.	1821	p. 87, pl. xviii, f. 1—4				*			*	*	*	*		*	
82	"	<i>concinna</i>	Sow.	1812	p. 88, pl. xvii, f. 6—12				*			*	*	*	*			
83	"	<i>subconcinna</i>	Dav.	1852	p. 90, pl. xvii, f. 17		*		*			*	*	*	*			
84	"	<i>obsoleta</i>	Sow.	1812	p. 90, pl. xvii, f. 1—5				*			*	*	*	*			
85	"	<i>subobsoleta</i>	Dav.	1852	p. 91, pl. xvii, f. 14				*			*	*	*	*			
86	"	<i>angulata</i>	Sow.	1825	p. 92, pl. xvii, f. 13				*			*	*	*	*			
87	"	<i>Morièrei</i>	Dav.	1852	p. 92, pl. xviii, f. 12, 13				*			*	*	*	*			
88	"	<i>tetraëdra</i>	Sow.	1812	p. 93, pl. xviii, f. 5—10		*	*	*			*	*	*	*			
89	"	<i>subtetraëdra</i>	Dav.	1852	p. 95, pl. xvi, f. 9—12				*			*	*	*	*			
90	"	<i>lacunosa</i> ?	Schl.	1813	p. 96, pl. xvi, f. 13, 14				*			*	*	*	*			
	"	<i>uncertain species</i>	....	....	pl. xviii, f. 18				*			*	*	*	*		*	
91	"	<i>Hopkinsii</i>	M'Coy		p. 97				*			*	*	*	*			

¹ At the period I described this form, I was only acquainted with the larger or perforated valve; but, during a visit to the Woodwardian Museum at Cambridge, I found there a beautifully perfect specimen, measuring, length 23, width 20, depth 16 lines: the smaller valve is, as I had supposed, very similar to that of *Ter. Bentleyi*. The general aspect of *T. sub-Bentleyi*, added to its different stratigraphical position, almost makes me believe it specifically different from *T. Bentleyi*.

² Mr. Walton states positively to have found this species in the Oxford Clay of Wootton Bassett. A figure of this form was given by Lister in 1688, tab. 459, fig. 20.

PLATE XIV.

Fig.			
1.	Rhynchonella	Wrightii, nat. size.	
2.	„	furcillata. Var., with two plaits on the mesial fold.	
3.	„	„ Var., with three plaits	„
4.	„	„ Var., with four plaits	„
5 ^a .	„	„ Var., with five plaits	„ enlarged.
6.	„	rimosa, nat. size.	
6 ^{a b c} .	„	„ enlarged.	
7.	„	oolitica, nat. size.	
7 ^{c d} .	„	„ enlarged.	
8, 9.	„	acuta, nat. size.	
10.	„	cynocephala. Var., with only one plait on the mesial form. This case is very rare in this species.	
11.	„	„ The common state or type, two plaits on the mesial fold.	
12.	„	„ Another rare variety, with three plaits on the mesial fold.	
13, 14.	„	ringens. Two specimens, nat. size.	
15.	„	„ A French specimen, type of the species placed here for comparison.	
16.	„	„ Another French specimen, figured, to show that sometimes the form varies from the original type, having in this most exceptional case three plaits on the mesial fold.	
17.	„	sub-ringens, nat. size.	
17 ^{a b c} .	„	„ enlarged figures.	

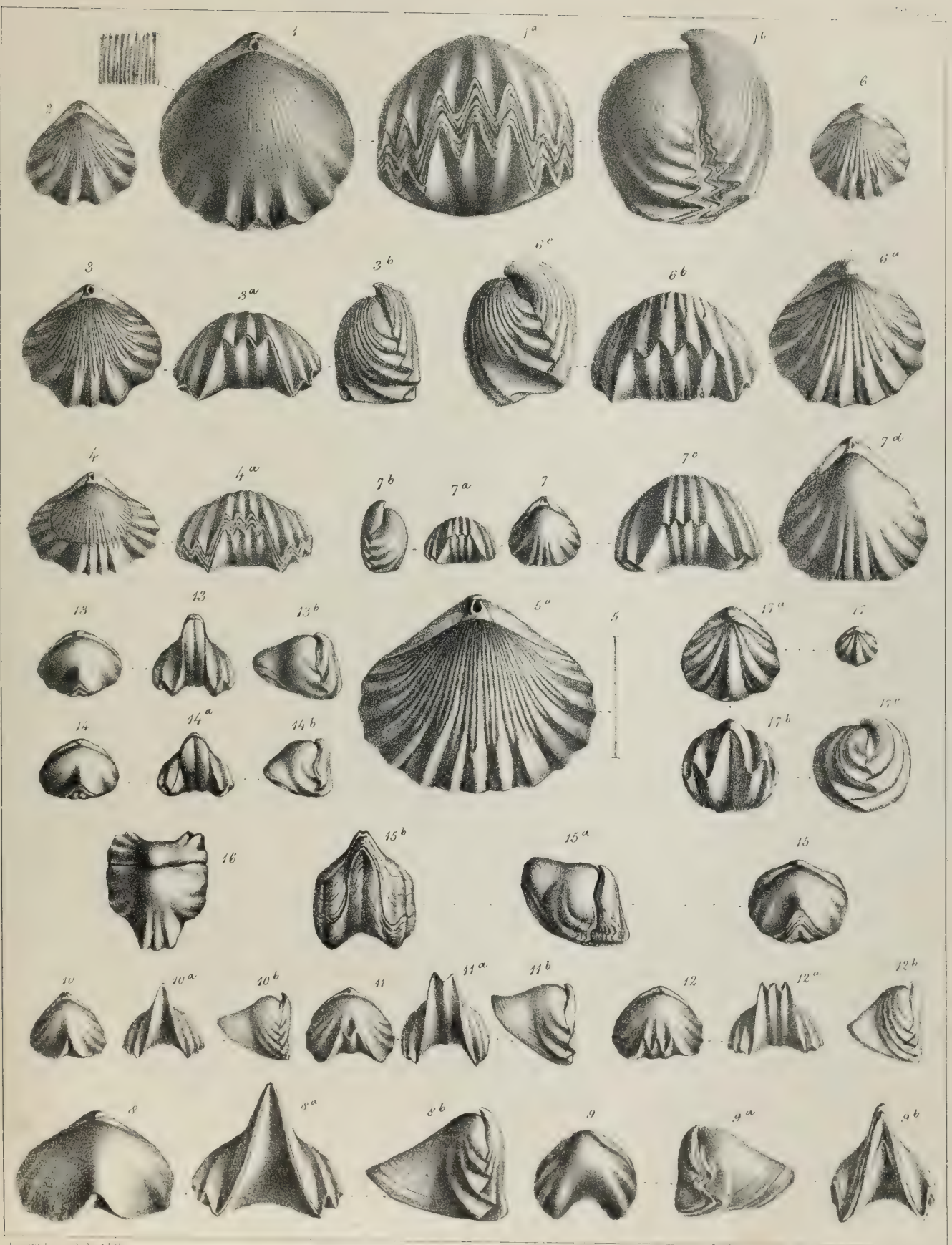


PLATE XV.

Fig.		
1, 2.	<i>Rhynchonella serrata</i> .	Two specimens, nat. size.
3.	„	<i>Bouchardii</i> . A var., with two plaits on the mesial fold, a little enlarged.
4.	„	„ A var., with three plaits, enlarged.
5.	„	„ A var., with five plaits „
6.	„	<i>Lycettii</i> , nat. size.
7.	„	<i>sub-variabilis</i> . A specimen with three plaits on the mesial fold; in Pl. XVIII, fig. 11, a var. is figured with only two plaits on mesial fold.
8, 9, 10.	„	<i>variabilis</i> . Three small varieties, with three and four plaits on mesial fold: other variations are illustrated in Pl. XVI, figs. 1 to 6.
11.	„	<i>Moorei</i> . A var. (enlarged), with five plaits on mesial fold.
12.	„	„ Another var., enlarged.
13, 14.	„	„ A variation, with seven plaits on mesial fold.
15.	„	<i>spinosa</i> . A specimen, with all its spines attached.
15 ^a .	„	„ A fragment, showing the manner in which the spines originate, enlarged.
16.	„	„ A var., with few plaits.
17, 18.	„	„ Beak of two specimens, enlarged, to illustrate the foramen and deltidium.
19.	„	„ The largest British specimen.
20.	„	„ A very young shell, enlarged, to show that sometimes the plaits bifurcate and intercalate.
21.	„	<i>senticosa</i> , nat. size.

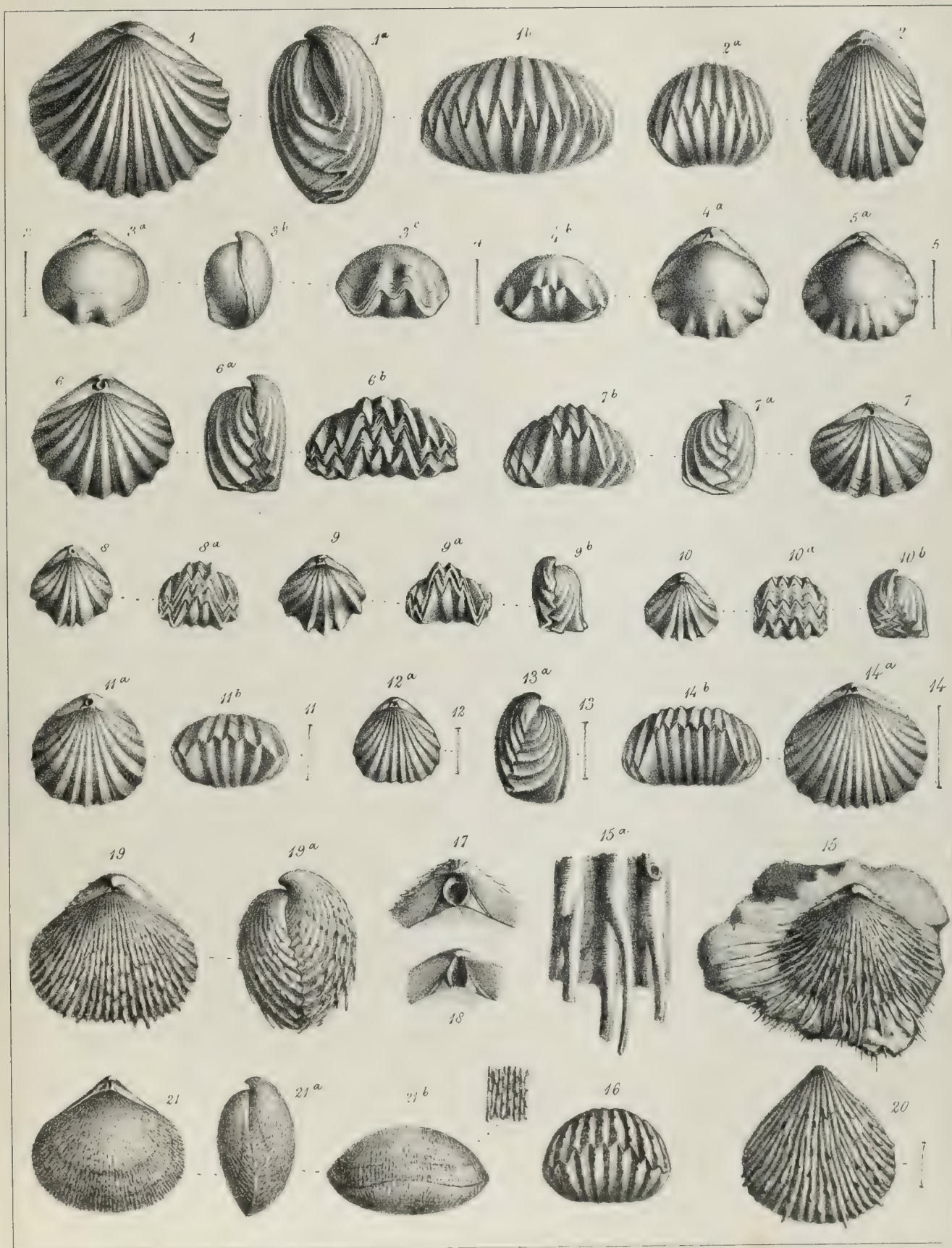


PLATE XVI.

Fig.			
1.	Rhynchonella variabilis.	Var., with two plaits on mesial fold, <i>Ter. bidens</i> of Phillips, nat. size.	
2.	„ „	A young shell, with two plaits.	
3.	„ „	A var., with three plaits on mesial fold, <i>Ter. triplicata</i> of Phillips, nat. size.	
4.	„ „	A variety with three plaits from another locality.	
5.	„ „	A young shell, with three plaits.	
6.	„ „	A variety, with four plaits.	
7.	„ plicatella.	The type form of the species.	
8.	„ „	A less aged and more elongated specimen.	
9, 10, 11, 12.	„ sub-tetrahedra.	Four varieties, nat. size, showing a difference in the number of the plaits; fig. 9 is the largest example I have seen.	
13, 14.	„ lacunosa.	I am not quite certain as to this determination; the specimens much resemble some German types of <i>R. lacunosa</i> .	
15.	„ ?	This shell is from the Lias of Sky, and my only inducement to figure it here is on account of the variety of Liasic species of Brachiopoda in Scotland. It has much the appearance of some young specimens of <i>T. quadriplicata</i> of Zieten.	





P L A T E X V I I .

Fig.

- | | | |
|-----------------------|------------------------------------|--|
| 1, 2, 3. | <i>Rhynchonella obsoleta</i> . | Different ages; fig. 1 is the largest example I have seen in England. |
| 4, 4". | „ „ | Interior, <i>a</i> , the two short curved lamella to which the arms were affixed; <i>b</i> , muscular impressions. |
| 5. | „ „ | Beak, showing the foramen entirely surrounded by the deltidium and separated from the umbo, which character distinguishes this species from <i>R. concinna</i> . |
| 6 to 12. | „ <i>concinna</i> . | Different stages of growth and varieties; figs. 9, 10. <i>T. flabellula</i> , of Sow., fig. 12, illustrates the beak, deltidium, and foramen. |
| 13. | „ <i>angulata</i> . | Drawn from Mr. Sowerby's original specimen and type. |
| 14. | „ <i>sub-obsoleta</i> . | The largest specimen I have seen. |
| 15. | „ <i>varians</i> , nat. size. | |
| 15 ^{a b c} . | „ „ | enlarged. |
| 16. | „ „ | Profile of another specimen. |
| 17. | „ <i>sub-concinna</i> , nat. size. | |
| 17 ^{a b c} . | „ „ | Enlarged figure. |
| 18. | „ ? | An undetermined form: it looks like a small <i>R. tetraëdra</i> , but is from the <i>Upper Calcareous Grits</i> of Scarborough, in the collection of Mr. Bean: having only seen one example, I have not ventured to give it a name, and place it here, from its being the only form I have observed from this bed. |
| 19. | „ <i>Forbesei</i> , nat. size. | |
| 19 ^{a b c} . | „ „ | enlarged figures. |

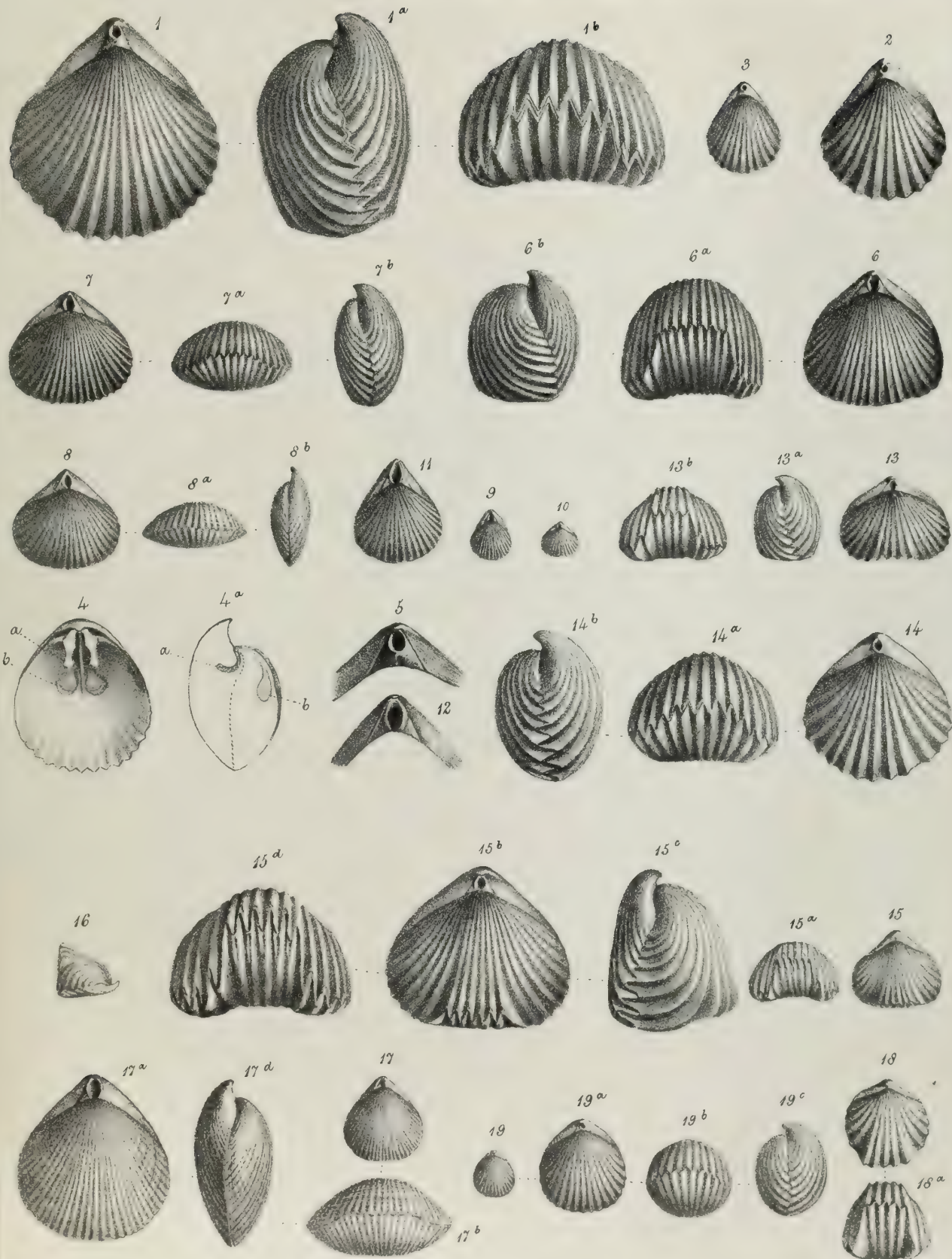


PLATE XVIII.

- | | | | |
|----------------|--------------|-----------------|---|
| Fig. | | | |
| 1, 2. | Rhynchonella | inconstans. | From the Kimmeridge Clay. In these two specimens the twist is differently disposed; fig. 1 is the largest example I have examined. |
| 3. | „ | „ | Another specimen from Kimmeridge Clay. |
| 4. | „ | „ | From the upper beds of the Inferior Oolite. |
| 5, 6, 7, 8, 9. | „ | tetraëdra. | Different varieties, with a variable number of plaits on the mesial fold; fig. 7 is the largest example I have seen, and forms a well-marked variety. |
| 10. | „ | „ | A most remarkable variation, approaching much to <i>R. decorata</i> , and said to be from the Inferior Oolite of Cheltenham. |
| 11. | „ | sub-variabilis. | A var., with only two plaits. Another specimen is figured in Pl. XV, fig. 7. |
| 12, 13. | „ | Morièrei. | Two specimens from the Cornbrash. |
| 14. | Lingula | ovalis, Sow., | nat. size, from the Kimmeridge Clay. |



THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

LONDON:

MDCCCLII.

A MONOGRAPH
OF
THE EOCENE MOLLUSCA,

OR
DESCRIPTIONS OF SHELLS FROM THE OLDER TERTIARIES
OF ENGLAND.

BY
FREDERIC E. EDWARDS.

PART II.
PULMONATA.

LONDON :
PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

1852.

To the Subscribers.

SHORTLY after the publication of the first part of the Monograph of the Eocene Mollusca, I received a note from Professor Owen, from which the following is an extract:—

“In reference to the theory of the siphon of the Nautilus, which you attribute to Mr. Wood, I know you will excuse my referring you to a passage (p. 331) of my Lectures on Invertebrata, in which that theory or function of the siphon is plainly though briefly laid down, and I am sure that our excellent Treasurer would be the last person to claim the exclusive credit of the idea, unless his right to it was based on a publication of it prior to 1843. The scrupulous care which characterises your reference to authorities, assures me that if you have overlooked the passage in my Lectures you will be glad to be referred to it.”

Although I had derived much pleasure and instruction from Professor Owen's admirable Lectures, I must confess that the passage referred to had escaped my recollection; and I greatly regret that this should have been the case, for I should have been glad to have availed myself of the powerful support it affords to the theory I advocated. For the convenience of those Subscribers to whom the Lectures are not immediately accessible, I shall extract the passage to which Professor Owen refers. After noticing Dr. Buckland's theory of the hydrostatic action of the siphuncle, and the objections against it, the Professor advances the opinions to which I have referred in the 'Monograph,' as to the function of the air-chambers being that of a balloon, and as to the mode in which the animal alters the specific gravity of its shell; and he concludes with the following paragraph,—the one referred to in his letter to me:

“Whatever additional advantage the existing Nautilus might derive by the continuation of a vascular, organised, membranous siphon through the air-chambers, in relation to the maintenance of vital harmony between the soft and testaceous parts, such, likewise, must have been enjoyed by the numerous extinct species of the tetrabranchiate Cephalopods, which, like the Nautilus, were lodged in chambered and siphoniferous shells.”

It is due to Professor Owen that I should, to the best of my power, repair my omission to refer to this eminently suggestive passage; and now, having brought it distinctly before the Subscribers, I leave it to them to decide as to whom the credit of the siphuncular theory in question is due.

F. E. E.

July, 1852.

CORRIGENDA.

Substitute *Sconce* for *Headon Hill*, at p. 65, line 24; at p. 70, line 13; and at p. 78, line 15.

A MONOGRAPH
OF THE
MOLLUSCA FROM THE EOCENE FORMATIONS
OF ENGLAND.

ORDER—*PULMONATA*. CUVIER.

PNEUMOBANCHIATA, *Lamarck*.

PULMOBRANCHIATA, *De Blainville*.

PULMONIFERA, *Fleming*.

THE Molluscs forming this order breathe the free air by means of a chamber termed the pulmonary sac or cavity, placed beneath the dorsal surface of the anterior part of the mantle, and communicating with the atmosphere by a lateral opening, which can be dilated or contracted at the pleasure of the animal. The roof and walls of this chamber are lined with a network of pulmonary vessels, by which the blood is exposed to the air, and the renewal of this vital fluid is effected by movements of the floor of the chamber, analogous with those of the diaphragm.

The Pulmonated Molluscs are furnished with eyes, which are either placed at the anterior extremities of two elongated cylindrical peduncles, or seated in the head of the animal. Most of the genera in which the eyes are pedunculated, are also furnished with shorter cylindrical tentacula, placed beneath the peduncles, but in some few instances these appendages are wanting. In the genera in which the eyes are sessile, the animal is furnished with two sub-cylindrical or compressed tentacles only. The sessile eyes are variously placed; in some genera they are seated at the inner sides of the bases of the tentacles; in others at the outer sides; and in others on the frontal disc. The peduncles and tentacles are both contractile, and in by far the greater number of genera they are also retractile, that is, capable of being withdrawn under the skin. They are eminently sensitive organs of touch.

The head is well developed, and the mouth is provided with an apparatus

consisting of a horny dentated plate, placed transversely across the upper part, and the sharp outer edge of which forms, as it were, the upper jaw. The cavity of the mouth is furnished with a thin cartilaginous tongue, the anterior extremity of which is of a flattened spoon-like form, and which plays against the edge of the horny plate, answering the purpose of an under jaw. The remainder of the tongue is rolled up into a tube closed at the end, and thickly covered with teeth, distributed in transverse rows of various forms. The number of these teeth is almost incredible, amounting, in one of the English slugs (*Limax maximus*) to nearly 27,000, and ranging in several of the snails from 10,000 to upwards of 20,000.* A dentition of a similar character prevails among the Branchiated Gasteropods; and Professor Lovén has proposed the employment, for the purposes of classification, of characters taken from the form and arrangement of the teeth.

The free air-breathing Molluscs are, in some few instances, viviparous,† but, for the most part, they are oviparous. The eggs are either enveloped in a skin, or are covered by a hard calcareous shell, which, among the larger Bulimi and Achatinæ, is sometimes of considerable size. The larvæ are in all cases shaped like the parent. The generative organs present various modifications; in some genera the animals are unisexual; but more generally they are hermaphrodite.

These Molluscs are, with few exceptions, provided with hard calcareous shells, which are sometimes either internal or partly concealed beneath the mantle, but more generally are external, and large enough to contain the whole, or nearly the whole, of the animal. In some genera the foot of the animal is provided with a calcareous or horny operculum; in others the animal is without this appendage, and in the genus *Clausilia*, the purpose of the operculum is answered by a peculiar apparatus termed the clausium. The external shells present many modifications in the proportions and conditions, as well of the spire and volutions, as of the aperture and columella. Certain of these forms are accompanied by corresponding peculiarities of organisation, and the genera which have been established for their reception may be considered types in this order; such are the genera *Helix*, *Bulimus*, *Pupa*, *Succinea*, *Limnæa*, *Physa*, *Planorbis*, *Cyclostoma*, *Helicina*, *Auricula*, &c., and the Palæontologist will have little difficulty in distinguishing them. Other genera, however, have been proposed from time to time on characters taken from modifications of these typical forms; but a more intimate acquaintance with the anatomy of the animals has latterly induced great caution in the admission of these genera; since, in many cases, the Malacologist, after the most careful investigation, has failed to detect any peculiarity of organisation corresponding

* For a more detailed account of the oral apparatus, the reader is referred to Mr. W. Thompson's highly interesting "Remarks on the Dentition of British Pulmonifera," in the 'Annals and Mag. of Nat. Hist.,' 2d series, vol. vii, p. 86.

† This is the case with some species of *Helix*, and with several species of *Bulimus*, for which Férussac, on this ground, proposed the genus *Partula*.

with the modifications of the shell. In the extensive family of the Helicidæ, most especially, has this occurred, and many of the genera thus formed are consequently either wholly rejected, or received provisionally until it is ascertained by further examination whether or not there is anything except merely artificial characters to support them.

The Gasteropods forming this order are all phytophagous. They are very widely spread, being found in almost all parts of the earth, but they principally abound in warm or tropical climates, where the largest species occur. They are, for the most part, inhabitants of land, but many live in water, coming to the surface for respiration; of those which live in water, the greater number inhabit ponds, running streams, or stagnant waters, but some few are marine animals, frequenting the shallow sea near the shores, or salt-water marshes.

Two distinct forms of the opening by which the communication between the pulmonary sac and the external air is kept up, are presented; and as each appears to be accompanied by corresponding peculiarities of organisation, Mr. Gray has availed himself of them for dividing the order into the two sub-orders, *Adelopneumona* and *Phaneropneumona*.* In the first division the communication is through a lateral orifice formed by the edge of the mantle, which, except at that part, is united along the left side of the animal; in the second division the edge of the mantle is free or detached along the nape, leaving the pulmonary cavity open. The animals comprised in the first division are all hermaphrodite, and without an operculum; while, on the contrary, those which form the second division are unisexual and operculated. The genera constituting this order had previously been divided, according to their habitats, into terrestrial and aquatic (*terricola* and *aquatica* of Dr. Fleming); a mode of distribution which brought together animals presenting important zoological differences. This principle of subdivision may, however, be used with convenience in the *Adelopneumona*, and Mr. Gray has, in fact, divided that sub-order into the three sections, *Geophila*, *Limnophila*, and *Thalassophila*, the last two representing the *aquatica* of Fleming.†

Mr. Webster many years ago, ('Geol. Trans.,' vol. ii,) noticed the occurrence in the Purbeck beds of fossils resembling fresh-water shells, and in the Museum of Practical Geology is a series of fossils from that formation, comprising *Limnæa* and *Planorbis*. Fossil remains, referred to the genus *Auricula*, have also been found, according to M. Nyst, in the chalk formation in the department of the Aube in France. In the

* Etym., *Αδελος*, (hidden, concealed,) and *φανeros*, (open, exposed,) prefixed to *πνευμων*, (the lungs.) These sub-orders correspond with the divisions *inoperculata* and *operculata*, proposed by Férussac, and adopted by Dr. Turton, M. Rang, and others, but as the names used by Mr. Gray express modifications of the respiratory apparatus, which forms the character of the present order, I have adopted them, although the words *operculata* and *inoperculata* are preferable from their simplicity.

† Etym., *γεια* (land), *λιμνη* (a pool or marsh), and *θαλασση* (the sea), respectively prefixed to *φιλος* (loving).

fresh-water deposits of the Eocene epoch, remains of numerous species belonging to various of the land and fresh-water genera, constituting this order, occur in abundance. These species are, for the most part, without any living analogue, but some few occur which appear to be identical with species still in existence.

I believe that, as yet, remains of land inhabiting genera have not been found below the Eocene formations. It must not, however, be assumed from that circumstance that these latter forms of animal life date their existence with the Eocene Epoch. The older formations with which Geologists are at present acquainted, are, with the exception of the Wealden group and the Coal-measures, of marine origin; and the preservation in them of the remains of land-shells would be due only to accidental circumstances. Individuals might occasionally be transported by rivers or currents of water into estuaries, or be swept away by an irruption of the sea. To such a cause is to be attributed the presence of a specimen of *Bulinus ellipticus*, found by Mr. Wetherell in the London Clay at Primrose Hill; but the number deposited in the bed of the deep sea by the agency of such casualties, must necessarily be small, and it need not excite surprise that their remains have not occurred in the older formations.

SUB-ORDER—*ADELOPNEUMONA* (Gray), *INOPERCULATA* (Férussac).

Sect. a. *TERRICOLA*, *Fleming*.

GEOPHILA, *Férussac*.

Family—*HELICIDÆ*.

Genus 6th. *HELIX*. *Linn.*, 1758; *Brug.*, 1792; *Lam.*, 1801.

Shell turbinated, orbicular, sub-globose, or depressed; spire more or less elevated, with several convex whorls, generally smooth; the last often large and ventricose; aperture entire, transverse, oblique, lunate, or semi-ovate, impressed by the prominent part of the body whorl, and sometimes furnished with one or more lamelliform teeth; peristome confluent with the columella, generally thickened internally, or having the edge reflected, especially on the side covering the umbilicus; without an operculum.

Notwithstanding that in Lamarck's time but little was known of the comparative anatomy of the animals belonging to this family, we must concur in the regret expressed by M. Deshayes (2d edit., 'Hist. Nat.' &c.) that that illustrious naturalist did not attempt a systematic arrangement of the numerous species forming this genus.

A much more intimate knowledge of the anatomy of the animals has since been acquired; and it appears that, although the shells present a great variety of forms, differences of organisation of importance sufficient to justify the separation of genera to receive them, do not exist, or, at all events, have not been observed in the animals. This strong general resemblance extends, in fact, to the whole of the

Helicidæ, and induced M. de Férussac to arrange the different genera as sub-genera merely of the typical genus *Helix*.

The present genus, as defined by Lamarck, embraces considerably more than a thousand living species; and may well be considered to be "deserving of subdivision, were it only to assist the student in the difficult task of investigation." Very many genera and sub-genera (amounting, including the synonyms, to nearly two hundred,) have, in fact, been proposed from time to time by different authors; but being nearly all founded, more or less, on conchological differences, they are, with few exceptions, rejected by the advocates of a strictly natural arrangement. M. Deshayes, one of the most able advocates for a system of arrangement dependent on anatomical structure, admits the convenience of having recourse to artificial divisions in this genus in which it is impossible to form natural groups; and suggests that the *Helices* may be classed, by the form of the shell, in four sections, consisting of the planorbular species, (*Zonites*, Montfort; *Helicella*, Lamarck,) the globose species, (*Acavus*, Montfort,) the carinated species, (*Iberus*, Montfort; *Carocolla*, Lamarck,) and the trochiform or turbiniform species (*Petasia*, Beck; *Geotrochus*, Swain.): and that these sections may be again subdivided into groups, according as the species are or are not umbilicated, have the aperture simple or reflected, or are or are not furnished with teeth.

The fossil *Helices* are more numerous than might be expected with respect to land-shells. Many extinct species, from the Freshwater deposits of the Paris basin, have been described by MM. Brogniart, ('Ann. du Mus.' vol. xv, p. 378,) Deshayes, ('Descr. des Coq. Foss.,' &c., vol. ii,) Matheron, ('Ann. des Sci. et de l'Indust. du Midi,' vol. iii,) Michaud, ('Guerin's Mag. de Zool.,' 1837,) De Roissy, ('Guerin's Mag. de Zool.,' 1839,) and Melleville, ('Mém. sur les Sables Tert. Inferieurs du Bassin de Paris,' p. 45;) and from the contemporaneous Freshwater formations in Germany by MM. Zeiten, ('Petr. Wurt.,' tab. xxix and xxxi,) Steininger, ('Bull. Soc. Géol. de France,' vol. vi,) Deshayes, ('Ency. Méthod. Vers.,) and Pusch, ('Polens. Pal.,' p. 94.) One species only, *H. globosa*, has as yet been described from the synchronous deposits in England; to this I am enabled to add eight species, one of which is identical with an existing species, *H. labyrinthica*, Say., found in North America.

Many species also occur, mixed with marine remains in the Miocene formations of Touraine, Dax, and Bordeaux, and in the Pleiocene formations of Piedmont, the Crag of England, and its equivalent in Belgium; of these but few are extinct, by far the greater number being referred to existing species.

Among the French species described by M. Deshayes is one (*H. dubia*), which, on the authority of Mr. Underwood, is mentioned as occurring in the Isle of Wight. I have not met with any specimen from that place; and M. Deshayes, as I learn from that gentleman himself, entertaining doubts as to the English locality, I have not considered *H. dubia* as an English species.

No. 14. *HELIX VECTIENSIS*. *F. E. Edwards*. Tab. X, fig. 8 *a—e*.

H. testá orbiculato-depressá, umbilicatá; superficie punctulis minutissimis confertis aspersá; spirá parum elevatá; anfractibus quinque sub-rotundatis, suturis depressis; aperturá semi-ovali, peristomate reflexo: umbilico profundo, semi-obtecto.

A somewhat convex shell, having the surface thickly covered with minute punctules. The slightly elevated spire is composed of about five bluntly convex whorls, depressed at the sutures. The aperture is semi-ovate, having the margins strongly reflected; that of the inner lip partly covering the umbilicus, which is deep and moderately wide. The shells, when in the young state, are, like many others in this genus, slightly carinated. In the general contour, this species much resembles the recent *H. rufescens*, but it is distinguished as well by the punctulated surface, as by the less rounded whorls, the more strongly reflected peristome, and the larger umbilicus.

Casts in the Linnæan limestone at Sconce are not uncommon; but specimens with the shell preserved are rare. The casts may be separated from those of *H. D'Urbani*, with which, at first sight, they are liable to be confounded, by the narrower umbilicus, and frequently by the impression of the reflected lip of this species. Where the shell is preserved, the punctulated surface presents a character by which it may be at once distinguished.

Diameter, 4-10ths of an inch; elevation, 2-10ths in.

Localities.—Sconce near Little Yarmouth, and Headon-Hill, Isle of Wight.

No. 15. *HELIX D'URBANI*. *F. E. Edwards*. Tab. X, fig. 5 *a—d*.

H. testá orbiculato-depressá, lævi, umbilicatá: spirá subprominulá; anfractibus quinque aut sex sub-rotundatis; suturis perspicuis: aperturá semi-ovali, peristomate simplici; umbilico magno.

A smooth, depressed, umbilicated shell, with a slightly elevated spire; the five or six volutions of which it is composed are bluntly convex, and the upper edges are so much depressed as almost to present a channel at the suture; the aperture is semi-ovate, with a perfectly simple unreflected lip; the umbilicus is wide, disclosing the volutions within.

This species somewhat resembles *H. Lemani* of Brogniart, but the spire is less elevated, and the umbilicus is more open.

The smooth and polished surface, which barely shows the lines of growth, and the sharp lip prevent its being confounded with *H. Vectiensis*. When young, the whorls are slightly carinated. A variety occurs in which the spire is much depressed, and the whorls consequently assume a less bluntly convex form.

The species is not uncommon; but most generally casts only are found. In that condition the wide umbilicus is the only character by which it can be separated from *H. Vectiensis*.

Diameter, 4-10ths of an inch nearly; elevation rather more than 2-10ths in.

Localities.—Sconce and Headon-Hill.

I have much pleasure in dedicating this species to my friend John D'Urban, Esq., whose Palæontological pursuits have enabled him to add several interesting species to our Eocene Fauna.

No. 16. *HELIX GLOBOSA*. *Sowerby*. Tab. X, fig. 2 *a—d*.

H. GLOBOSUS. *Sow.* 1818. *Min. Con.*, vol. ii, p. 157, t. 170.

— *Morris*. 1843. *Cat. of Brit. Fos.*, p. 147.

H. testá globoso-conoideá, apice obtuso: anfractibus sex aut septem, transversim substriatis, ultimo anfractu ad basin convexo; striis numerosis, irregularibus, tenuissimis; suturis perspicuis; aperturá depressá, semi-lunari, marginibus reflexis; columellá sub-rectá; umbilico oblecto.

This well known shell is globosely conical, with an obtuse apex; the spire is formed of six or seven whorls, which exhibit obscure, transverse, irregular striæ, or lines of growth, so faint that, as Mr. Sowerby remarks, they are only to be seen in the best preserved specimens. The base of the shell is very tumid, rising from the periphery of the whorl with a bluntly convex swell until it nearly reaches the umbilicus, into which it sinks abruptly, imparting an almost vertical slope to the columella. The aperture in the adult shell is semilunate and depressed, with the margins reflected, that of the inner lip entirely concealing the umbilicus. The young shell, like that of all the globosely conical shells of this genus, presents a form very different from that of the mature one. When in the young state, the whorls are subcarinated, increase rapidly in size, and consequently are very convex, giving a sub-quadrate form to the aperture; and the shell presents a small umbilicus: but, as the shell approaches maturity, they lose their sub-carinated form, increase in size more and more slowly, and become less and less convex in their contour, so that, in the mature state, the aperture assumes a semilunate form, and at this period of growth the umbilicus is concealed by the reflected margin.

Specimens with the shell preserved are extremely rare, but casts in all stages of growth are comparatively common at Sconce Point. In the young state the casts resemble those of *Helix oclusa*; but the flattened base, the shorter and more oblique columella, and the semi-ovate aperture, serve to distinguish the latter species.

I am indebted to Mr. Sowerby for the use of the original specimen described

in the 'Mineral Conchology,' from which the larger figures are taken; fig. 2 *a* is from a specimen in the cabinet of Mr. D'Urban.

Diameter, 2 inches; elevation, 2·3 in.

Localities.—Shalcome (near Ryde) and Sconce, Isle of Wight.

No. 17. *HELIX OCCLUSA*. *F. E. Edwards*. Tab. X, fig. 10 *a—e*,

H. testá sub-globosá, fulvo uni-fasciatá; spirá prominulá, quinquies vel sexies circumvolutá; anfractibus convexiusculis, ad suturam depressis, obscure ad basin striatis, subplanulatis; aperturá semi-ovatá, marginibus parum reflexis: margine columellari umbilicum occludenti.

A sub-globose shell, with a somewhat elevated spire, composed of five or six rapidly enlarging convex whorls, depressed round the suture, and flattened on the base. The surface presents numerous, very faint, oblique, irregular striæ, produced by the lines of growth. The aperture is of a regular semi-ovate form, having the margins slightly reflected; the inner lip spreads over, and entirely closes the umbilicus. The shell is ornamented by a narrow, brownish-yellow band running round the whorls, just above the line of the suture, the colouring matter of which is retained, more or less, in all the specimens I have seen, in which the shell is preserved.

This is a well-marked species, easily distinguishable when the shell is preserved. The casts, which are more commonly found, resemble those of the young shell of *H. globosa*, but can be separated from them without difficulty by the flattened base and oblique columella which present a strong contrast with the tumid base, and nearly vertical columella of that species. The smaller number of the whorls and the narrower umbilicus separate it as distinctly from *H. Vectiensis* and *H. D'Urbani*.

Diameter, 1·2 in.; elevation, $\frac{3}{4}$ in., nearly.

Localities.—Sconce and Headon Hill, where it occurs more rarely than any of the preceding species.

No. 18. *HELIX TROPIFERA*. *F. E. Edwards*. Tab. X, fig. 3 *a—c*.

H. testá orbiculari, supra plano-convexá, subtús convexo-turgidá, umbilicatá: spirá plus, minusve elevatá; anfractibus quinque aut sex, ad peripheriam subcompressis, et carinatis; aperturá transversá, subtrigoná; marginibus reflexis umbilico magno.

I have seen two specimens only, both casts, of this *Helix*; from the character of the whorls and the aperture it would belong to Lamarck's genus *Carocolla*,—the *Chilotrema* of Dr. Leach. It is an orbicular shell, with a slightly elevated spire, apparently variable in height; the upper sides of the five or six whorls, of which it is formed, are nearly flat, and somewhat compressed near the periphery, which presents a

sharp keel; the under side is tumidly convex, rising with a regular swell until it approaches the umbilicus, into which it sinks rather suddenly, presenting a blunt angle which defines the umbilicus. In the smaller of the two specimens, the spire is more elevated, and the underside of the body-whorl more convex than in the other. The umbilicus is deep and moderately wide; the aperture transverse, and wider than long. The specimen figured exhibits the impression of a slightly reflected peristome.

The present species is much less than the recent *H. lapicida*, the umbilicus is smaller in proportion, the keel round the whorls more prominent, and, judging from the cast figured, which appears to be that of a fully-grown shell, the aperture at maturity does not present the downward inflection which characterises *H. lapicida*. The condition of the keel is apparently a character of little value, inasmuch as it varies considerably in specimens of *H. lapicida*, some of which, particularly in the young state, have it as acute and prominent as that of the present shell.

The smaller size of the umbilicus, and the absence of the downward inflection of the aperture, are the most important differences; but these characters, even if constant, would scarcely justify my considering the shell as more than a variety. With only two specimens, however, and those casts, I do not venture to pronounce as to their identity with the recent species. If, on more perfect specimens being obtained, it should appear that the shell presents the granulated surface which characterises *H. lapicida*, I should feel little hesitation in referring it to that species.

The specimen figured belongs to Mr. D'Urban's collection.

Size.—Diameter, $\frac{1}{2}$ an inch; elevation rather more than 2-10ths in.

Locality.—Headon Hill, where, however, it is extremely rare.

No. 19. *HELIX OMPHALUS*. *F. E. Edwards*. Tab. X, fig. 5 *a—e*.

HELIX STRIATELLA. *S. Wood*. Lond. Geol. Journ., vol. i, p. 118.

H. testá planorbulari, depressá, undato-costulato-lineatá, umbilicatá: anfractibus quaternis, convexiusculis; suturis conspicuis, depressis: aperturá rotundato-semi-lunari; marginibus simplicibus; umbilico magno.

This shell, which belongs to the section represented by *Zonites*, Montfort,*

* The genus *Zonites*, as defined by Mr. Gray, embraces those *Helices* which have a depressed spire and a lunate mouth, with thin simple lips. It is divided into two sections—*Verticillatæ* (Fér.), in which the shell is brown, or varied, and striated; and *Hyalinæ* (Fér.), in which the shell is hyaline, greenish or pale brown, and polished. It appears, from the observations of Mr. W. Thompson, to which I have before referred, that, judging from the characters afforded by the dentition, the animal of *Z. radiatus* (one of the *Verticillatæ*) is a true *Helix*; but that in four species of the *Hyalinæ* examined by him, the animals would form a connecting link between *Vitrina* and the true *Helices*. Professor E. Forbes and Mr. Hanley, in their 'History of British Mollusca,' restrict the genus to the Hyaline species.

(*Helicella*, Lamarck,) is somewhat discoidal, with a slightly elevated spire formed of about four whorls, generally rounded or bluntly convex, but which, in two casts of fully grown individuals in my cabinet, present a sub-carinated periphery. The surface is covered with numerous regular raised lines, separated by shallow rounded sulci; the lines are oblique, undulating, and rounded. The margins of the depressed semilunar aperture are simple and unreflected. The umbilicus is moderately wide.

Mr. S. Wood, in his 'List of Shells from Hordwell Freshwater Bed,' has referred this shell to the North American species, *H. striatella*, Anthony; but, although I feel great hesitation in dissenting from his opinion, the differences between the two render it difficult to maintain their identity, at all events, before we are better acquainted with the influence of external conditions in modifying the forms of the animal and its shell. I should add that I have only one specimen with the shell preserved, (the one referred to by Mr. Wood, and which he has been kind enough to add to my collection,) and that this specimen is in an imperfect state. On comparing this shell with the recent *H. striatella*, it will be seen that in the latter species the spire is more elevated, the lineation sharper, the sulci not so deep, the whorls wider, rounder, and less embracing; the suture not so depressed, and the aperture larger. Similar differences exist between this and *H. ruderata*, a species from Cincinnati described by Binney. In *H. perspectiva*, Say, which it somewhat resembles, the spire is more depressed, the lineation, like that of *H. striatella*, is fainter and sharper, the volutions more numerous, the peritreme more distinctly carinated, and the umbilicus wider.*

A shell occurs in the Pleistocene freshwater deposit at Clacton, which is referred to *H. ruderata*: the striation resembles that of the present shell; but in other respects it very closely resembles the American shell. M. Deshayes has described a fossil shell from the upper freshwater formation of the Soissonnais (*H. Ferrantii*), to which this species presents a general resemblance; but it is separated from that shell by the more elevated spire, and the more numerous whorls; and in *H. Ferrantii* the raised lines appear to be fewer and less regular, and the umbilicus to be narrower.

Size.—Diameter $\frac{1}{4}$ of an inch, nearly; elevation 1-10th inch.

Localities.—Hordwell Cliff; Sconce.

* The *H. striatella* of Anthony is from Massachusetts, and, until recently, was considered to be merely a variety of Say's *H. perspectiva*, which is from Ohio and Lake Erie. Gould, in his 'Report on the invertebrate Animals of Massachusetts,' has pointed out the distinctions. The *H. ruderata* of Binney is from Cincinnati, and has also been considered as a variety of *H. perspectiva*; it appears to belong rather to *H. striatella*.

No. 20. *HELIX LABYRINTHICA*. Say. Tab. X, fig. 7 *a—e*.

<i>HELIX LABYRINTHICA</i> .	Say. Journ. Acad. Nat. Sc. Philadelphia, vol. 1, p. 124.
—	— <i>Nicholson's</i> Encycl. (Amer. Edit.), 4.
—	— <i>Férussac</i> . Hist. Natur. des Moll., tab. li B, fig. 1; <i>Prodromus</i> , No. iii.
—	— <i>Binney</i> . Boston Journal Nat. Hist., vol. iii, tab. xxiv, fig. 1.
—	— <i>Gould's</i> Report of the Inverteb. of Massachus., p. 184.
—	<i>LABYRINTHICUS</i> . <i>S. Wood</i> . Lond. Geol. Journ., vol. i, p. 118.

H. testá minimá, globoso-conicá, transversim lineatá, umbilicatá; lineis obliquis, undosis, numerosis; spirá plus minusve elevatá, sexies circumvolutá; anfractibus convexis ad basin sub-planulatis: aperturá depresso-semilunari, peristomate reflexo: margine columellari uno dente lamelliformi instructo: umbilico magno, profundo.

This pretty and very rare *Helix* is a small, roundedly-conical shell, with a more or less elevated spire, composed of about six gradually increasing whorls, separated by a clearly defined suture, and ornamented with numerous, elevated, obliquely transverse, equidistant, raised lines, more or less prominent in different individuals. These lines are somewhat acute, slightly undulated, and, running into the umbilicus, cover the whole surface of the whorls. The base of the shell is but slightly convex; the aperture of a depressed semilunar shape, with the peristome reflected. The columella lip presents a large lamelliform tooth, prolonged within the aperture, and running parallel with the suture. The umbilicus is deep and wide, being about one third of the diameter. In one specimen in my cabinet, the spire is very much depressed, almost planorbular, and the apex more obtuse.

This species derives additional interest from the fact that, having survived through the inconceivably long spaces of time required for the deposit of the Miocene and the more recent formations, and having become extinct in the hemisphere in which it first appeared, it is now found among the living forms of North America. The recent *Helix labyrinthica*, first described by Say, is spread over a wide range of country, extending from Ohio to Florida, and from Missouri to Texas. Specimens from Texas, Ohio, and Florida are preserved in the British Museum; and, after a careful comparison with them of the fossil shells, it appears to me that differences of sufficient importance for specific distinction cannot be detected between them; I therefore fully concur with Mr. S. Wood in the opinion expressed by him of their specific identity, and I do not hesitate to refer the fossil shell to Say's species.

In order to facilitate an examination into this identity, it will be useful to give Say's description in his own words. It is as follows: "Shell conic, dark reddish-brown; body lighter; whorls five or six, with conspicuous, elevated, equidistant, obtuse lines across, forming grooves between them; apex obtuse; lip reflected,

rounded; pillar-lip with a large, lamelliform, elongated tooth, which appears to revolve within the shell parallel to the suture; a smaller raised line revolves nearer to the columella within the shell, but becomes obsolete before it arrives at the pillar-lip. Umbilicus large. Breadth 1-10th of an inch."

Taking the Texas shells, the form described by Say as the typical form of the American species, the fossil shell presents, on comparison, the following variations:

1st. The shell is somewhat smaller; the spire, except in the specimen I have noticed, is more elevated, the apex not so obtuse, and the whorls are less convex.

2d. The base of the shell is flatter, and the aperture not so rounded.

3d. The position of the larger raised line is more median, and the smaller raised line is wanting; and,—

4th. The peristome is simply reflected, and not "rounded" or thickened.

Now it will be seen that the differences firstly mentioned are such as frequently occur in a series of individuals of the same species. The variable height of the spire, evidenced in the fossil shells by the depressed form of the specimen before mentioned, is a character also found in the recent species; since Gould, in his work above cited, states expressly that "the shell varies considerably in the elevation of the spire, being sometimes much flattened, and again it has a pointed apex;" an observation, the accuracy of which the Florida specimens in the British Museum fully confirm; and this difference in the elevation of the spire will depend on, and in fact will denote, the less or greater convexity of the whorls.

With respect to the flatter base, and the consequently less rounded aperture, the same specimens from Florida exhibit a similar departure from the type; in one instance, indeed, the base is so much flattened as to impart a sub-carinated form to the basal periphery of the whorl.

The position of the larger tooth is equally variable in the Texas specimens; and, as regards the absence of the second or smaller raised line, Gould says that, "usually but one of them (*i. e.* of the raised lines) exists;" a statement, in fact, borne out by some of the specimens from Ohio in the British Museum, in which the second line is not perceptible.

It is evident, then, that these variations, occurring as they do in the recent shells, cannot afford sufficient grounds for a specific distinction of the fossil shell; and the only difference which apparently does not elude us on comparison, is the thickened or, as Say describes it, the rounded outer lip of the recent shells. To rest specific distinction on this character, one which, in general, is only an attribute of maturity, and which, even if constant, could, at the utmost, merely serve to designate a variety, would be an excess of refinement. But it cannot be affirmed that this variation is constant, and a larger series of the fossil shells may show that even the thickened outer lip is not wanting. Of the influence of varied conditions in modifying the form of shells, very little is known or even conjectured; but we may reasonably believe that

a change in the ordinary conditions of temperature, and of the nature and supply of food, will be attended with appreciable differences in the development, although not in the organisation, of the animal; and that these differences will be represented in, and will modify the form of the shell. And to such a cause, perhaps, may be attributable the distinction, trivial as it is, which, as we have seen, exists between the shell of the living *H. labyrinthica* and those of its Eocene representatives.

The identity in question exhibits an instance of a terrestrial species surviving important geological changes, and prolonging its existence through geological epochs of very great extent, but to the probable duration of which no approximation even can be made and yet preserving its normal form almost without modification; an instance unparalleled, if, as will probably prove to be the case, the various forms of *Terebratula* referred to the recent *T. caput-serpentis* belong to different species.

Brogniart, ('Ann. du Muséum d'Histoire Naturelle,' tom. xv, p. 380,) has described a small trochiform *Helix* from the neighbourhood of Mans (*H. Menardi*), which, in the general character of its lineation, resembles this species. It is, however, larger; and the whorls, although described as being "nearly equal," appear, from the figure given, to enlarge more rapidly. The aperture is neither described nor represented, and it is impossible, therefore, to form any opinion as to the identity of the shell with the present species.

Size.—Diameter, 1-10th in.; elevation 1-10th in.

Localities.—Hordwell Cliff; Headon Hill.

NO. 21. *HELIX SUB-LABYRINTHICA*. *F. E. Edwards*. Tab. XI, fig. 4 *a—c*.

H. testá minimá, globoso-conicá, umbilicatá; spirá elevatá, apice obtuso: anfractibus sex, rotundato-convexis, gradatim majoribus, transversim lineatis: aperturá, obliqua, semilunari, simplici (?) ; umbilico parvo.

I possess only one specimen, and that merely a cast, of this small and very rare *Helix*. Although more pupiform than *H. labyrinthica*, it approaches so nearly to that shell that I feel great hesitation in referring it to a distinct species; on examination, however, differences appear which scarcely justify my describing the shell as merely a variety.

It is a small, globosely conical shell, with an obtuse apex, and formed of six roundedly convex whorls, increasing in size very slowly. The impression of the whorls in the matrix presents a faint lineation, too regular to be due to lines of growth merely. The aperture is oblique and semilunar, but is too imperfect to enable me to say whether the peristome was or was not thickened or reflected. On the outer lip of the penultimate whorl are two linear impressions similar to those produced by lamelliform teeth, to the presence of which they may, perhaps, be attributed; but

they are not continued towards, and do not appear at, the aperture. The columellar lip does not present any evidence of teeth. The umbilicus is rather small.

On comparing this shell with *H. labyrinthica*, the distinctions appear to be that, in the present species, the apex is more obtuse, approaching, in that character, more nearly to the recent specimens of that species; the whorls enlarge more slowly, are more roundedly convex, and but slightly, if at all, flattened on the base; the aperture, partaking of the character of the whorls, is rounder, and the teeth, if present, are on the outer lip, and not on the columellar lip, as in *H. labyrinthica*; the umbilicus is smaller, and, if the shell were preserved, would, I think, be nearly closed.

Having only seen the single specimen in my collection, I propose the species with hesitation, although the characters seem to me sufficient for specific distinction.

Size.—Elevation 1-10th in. nearly; diameter 1-10th in., nearly.

Locality.—Headon Hill.

NO. 22. *HELIX HEADONENSIS*. *F. E. Edwards*. Tab. XI, fig. 5 a—d.

H. testá minutá, orbiculari, sub-depressá, umbilicatá; spirá prominulá; anfractibus sex, rotundatis, suturis perspicuis: aperturá rotundato-semi-lunari, obliquá; peristomate incrassato, reflexo; margine externo tribus lamellis, penitissime decurrentibus, instructo: umbilico lato, profundo.

A very small depressedly orbicular shell, with a somewhat elevated spire, composed of six or seven rounded whorls, separated by a deep suture; the rounded aperture is oblique, and impinged upon by the body whorl, which gives to it a semi-lunar shape; the peristome is slightly thickened internally, and reflected; and the outer lip is furnished with three lamelliform teeth, extending far back into the whorls; the umbilicus is wide and deep.

The *H. Headonensis* is apparently extremely rare; my specimen, which I believe to be unique, is merely a cast, and the outward condition of the shell is not shown. The species presents some analogy with the depressed variety of *H. labyrinthica*; but the greater number of the whorls, and the different dentition of the aperture, distinguish it from that shell. In general appearance it resembles the recent *H. pulchella*; but the spire is more elevated, the whorls more numerous, and, in the latter species, the aperture is without the plaits which characterise the present shell. The species appears to be well marked and perfectly distinct.

Size.—Elevation rather more than 1-20th in.; diameter 1-10th in.

Locality.—Headon Hill.

Genus 7th. BULIMUS.* *Scopoli*, 1786.BULIMUS, *Brug.*, 1792; *Lam.*, 1801.COCHLEA, *Adanson*, 1757.COCHLOSTYLA, *Férussac*.

Gen. Char.—Shell oval, oblong, or turriculated, smooth, or longitudinally striated; spire obtuse, variable in length and in the number of the whorls, which are generally few, and for the most part sinistral; aperture entire, oval, rounded anteriorly; outer lip simple, generally reflected and confluent with the columella; inner lip reflected over the body whorl; columella smooth.

This genus, originally proposed by Scopoli, was adopted by Bruguière, and extended so as to comprise animals essentially different in their organisation; many genera have, in consequence, been since separated from it by Draparnaud, Lamarck, and others. The animal closely resembles that of *Helix*; but M. Deshayes states that it presents a modification of the organs of generation sufficient for generic distinction. The shells may be known from the *Helices* by their more elongated spiral form; from the *Limnææ* by the smooth columella, and from *Pupa* by the more regularly tapering spire.

The genus contains very many living species distributed over the equatorial, tropical, and warm temperate regions, as well of the new, as of the old, world. According to Mr. Lovell Reeve† the localities of nearly 600 species have been ascertained; and of these, three fifths inhabit the western hemisphere, principally central America; and a large proportion, rather more than one third, of the remaining species is found in the Phillippine Islands.

Several fossil species, from the Freshwater deposits of the Paris Basin, have been described by MM. Brard, Brogniart, Lamarck, Defrance, Matheron, and Deshayes; and two distinct species (*B. ellipticus*, Sow., and *B. politus*, nov. spec.,) occur in the

* The etymology of this word is not ascertained. Adanson in 1757, in his 'Histoire Naturelle du Sénégal,' applied the name *Bulinus* to a species of the shells which afterwards formed part of Draparnaud's genus *Physa*, but which have since been separated by Dr. Leach, under the generic name *Aplexus*; and the writer of the article "Limneans," in the 'Penny Cyclopædia,' suggests, and apparently with much probability, that the word *Bulimus* was used by mistake by Scopoli and Bruguière for *Bulinus*. Studer seems to consider *Bulimus* to have been intentionally substituted for *Bulinus*, and says that the alteration is altogether inadmissible; and Hartmann and Mr. Broderip concur in rejecting the name. Herrmannsen fancifully derives the word from *βουλιμος*, *ingens fames*, in allusion, I presume, to the voracity of the animal. The name *Bulimus*, however, whatever may be its origin or meaning, appears to be generally adopted, and I have therefore retained it.

† Mr. Lovell Reeve, "On the Geographical Distribution of the Bulimi," &c., 'Ann. and Mag. of Nat. Hist.,' 2d ser., vol. vii, p. 241.

contemporaneous deposits in England. The shell described by Mr. Sowerby ('Min. Con.,' vol. iv, p. 89 bis, t. 366), as *B. costellatus*, is an Achatina. Two of the French Eocene species have been found, mixed with marine remains, in the Faluns of Touraine; but, as yet, no species has been found below the Eocene formations.

No. 23. *BULIMUS ELLIPTICUS*. Sowerby. Tab. XI, fig. 2 *a—f*.

BULIMUS ELLIPTICUS. Sowerby. 1822. Min. Con., vol. iv, p. 46, t. 337.

— *TENUISTRIATUS*. G. Sowerby, jun., 1846. Lond. Geol. Journal, vol. i, p. 20.

B. testá sinistrorsá, ovali, elongatá; apice obtuso: anfractibus plano-convexis, superné sub-canaliculatis; transversim lineatis; lineis obliquis, irregularibus, plus minus-ve numerosis; aperturá sub-auriformi, peristomate simplici, margine columellari reflexo.

A sinistral, cylindrically-conical shell, with an apex more or less obtuse in different individuals; the whorls are slightly convex, depressed at the upper margin so as to form an obscure channel running parallel with the suture, and covered with numerous transverse raised lines, which are rounded, oblique, and vary considerably in number, frequently in the same specimen. The aperture is oblong and ovate; the sharp outer margin is slightly reflected where it joins the columella, and is frequently thickened as it spreads over the body-whorl.

Fig. 2 *f* is taken from a specimen belonging to Mr. Wetherell, found in the excavations in the London Clay at Primrose Hill for the London and Birmingham Railway. The lineation of this fragment is fainter and more crowded, and the whorls appear to be more angular at the base than in *B. ellipticus*; these distinctions induced Mr. G. Sowerby to refer the shell to a distinct species. The faintness of the transverse lines is, however, due to the worn state of the shell, which has apparently lost the outer layer; and their number is a character too uncertain to be relied upon. The specimen represented by fig. 2 *a*, from Mr. D'Urban's collection, shows on one side of the penultimate whorl, lines nearly as crowded as those on the Highgate specimen, while those on the opposite side of the same whorl are moderately distant; and I have in my own collection a specimen, beautifully preserved, in which the same discrepancy occurs. The angularity of the whorls is a character frequently found in shells in an early stage of their growth, and I have several young shells of this species, in which the whorls present a clearly defined angle running round the basal periphery. On these grounds I have referred the specimen in question to the present species.

A form occurs at Binsted, near Ryde, in which the whorls are flatter than in ordinary specimens, and sub-turritid; in other respects it agrees with this shell, of which, therefore, I consider it to be only a variety.

Size.—The specimens ordinarily found rarely exceed $2\frac{1}{2}$ inches in length by 9-10ths of an inch in diameter; one specimen, however, in my collection is above 3 inches long, and rather more than 1 inch and 2-10ths in diameter; and the shell from which fig. 2 *c* is taken, forming part of the valuable collection of the late Mr. Dixon now in the British Museum, must have exceeded even those dimensions.

Localities.—Shalcombe, Binstead, Sconce, in the Isle of Wight.

No. 24. *BULIMUS POLITUS*.

. Tab. XI, fig. 1 *a—d*.

B. testá conicá, lævissimá, politá; apice deciduo; anfractibus sub-convexis; aperturá ob-ovali, anticé effusá, postice sub-angulatá, peristomate incrassato, reflexo.

The occurrence of this shell in the fluvio-marine deposit in Headon Hill in such abundance as almost to be inconsistent with the supposition that it is a land shell, suggests that it might be placed with those Paludinæ, in which the margins of the aperture are thickened or reflected, and of which an instance (*Paludina Chastellii*, Nyst,) occurs in a similar formation in Hampstead Cliff. The aperture, however, and the smoothness of the surface, place it, perhaps, more correctly in the present genus, although the latter character is frequently shown in well-preserved specimens of *Paludina* found in a somewhat similar matrix.

The shell is conical, with a smooth polished surface, on which faint lines of growth are barely perceptible; the apex is subject to decollation, leaving about four convex whorls; the last of which, somewhat like that of *Nematura*, is slightly contracted near the aperture, which is rounded and very effuse in front, and angulated behind; the peristome is thickened and reflected. The length of the aperture is about 2-5ths of that of the whole shell.

The specific name is one by which the shell is generally known. I do not know by whom it was imposed, but it well describes the smooth and polished appearance of the shell, and I have therefore retained it.

Size.—Elevation 2-10ths of an inch; Diameter 1-10th in.

Locality.—Headon Hill.

Genus 8th. *ACHATINA*.* *Lamarck*.

COCHLITOMA, Férussac.

Gen. Char.—Shell oval or oblong, subturreted, with an elevated spire; generally smooth, but sometimes longitudinally striated: aperture oval or pyriform, generally greater in length than in width; outer lip thin, never thickened or reflected; columella

* Etym., Diminutive of *Αγαθος*, beautiful; or of *Αχαρης*, an agate.

smooth, inflected and truncated at its base, forming a slight notch where it joins the outer lip.

The third division made by Bruguière in his genus *Bulimus*, consisting of those species in which the columella is truncated at the base, was formed by Lamarck into the present genus. From this Montfort withdrew his genera *Liguus*, (*Chersina*, Humph.) consisting of the conical forms in which the aperture is short and nearly round; and *Polyphemus*, comprising the oblong sub-turreted species, with an undulating outer lip, to which Bolten had already given the name *Oleacina*, and which forms the genus *Glandina* of Schumacher and Say, and the sub-genus *Cochlicopa* of Férussac.

As some of the Bulimi present a sharp outer lip, the truncation of the columella appears to be the only character by which the Achatinæ can be separated from that genus, and the value of this character must depend on its being the result of some peculiarity of generic importance in the organisation of the animal. M. De Blainville states that he has observed in the animal of *Achatina zebra* an interruption in the collar where the two sides unite, as if caused by the exsertion (saillie) of the columellar muscle, and to this he attributes the truncation of the columella; but, according to Férussac, this truncation is not the result of any peculiar organisation, as is the case in other molluscos animals, the columella of whose shells present this character; and that author therefore unites the Achatinæ to his genus *Helix*, of which they form the sub-genus *Cochlitoma*; and M. Deshayes, on account of the similarity of organisation presented by the animals of *Bulimus* and *Achatina*, proposes to re-unite *Achatina* with *Bulimus*. The genus, however, is very generally adopted as well by English as by foreign Malacologists, and I have therefore retained it.

The subdivisions proposed by Bolten and Montfort depend on the proportions and other characters in the shell, of trifling importance, which are generally considered as insufficient for generic distinction, however useful they may be for the division of a genus into sections. The recent species *A. glans*, and the cognate species which form the genus *Glandina*, are confined to the West Indian Islands, and the adjacent parts of the American Continent; and the peculiar form of the outer lip may be used with convenience, as one of the indications of the limits of geographical distribution of species.

The Achatinæ are generally large shells; some, in fact, attain a greater size than any other land shells at present known, and many are covered with an epidermis. Although generally dextral, they are in some species constantly sinistral. They are found chiefly in tropical climates, and, according to Blainville, in marshy lands. Some few are European, but only one or two small species occur in England. One fossil species (*A. pellucida*) has been described by M. Deshayes from Parnes; and Bouillett, in his catalogue of the fossil shells of Auvergne, has given another species, which he refers to the recent *A. acicula* (Lamarck).

No. 25. *ACHATINA COSTELLATA*. Sowerby. Tab. XII, fig. 1 *a—k*.

BULIMUS COSTELLATUS. Sow. Min. Con., vol. iv, p. 89 bis, t. 336.

LIMNEA MAXIMA. Sow. Ib., vol. vi, p. 53, t. 528, fig. 1.

BULIMUS COSTELLATUS. Morris. Cat. of Brit. Foss., p. 140.

LIMNÆUS MAXIMUS. Morris. Ib., p. 148.

A. testá ovato-oblongá, apice sub-acuto; anfractibus sex convexiusculis, longitudinaliter costellatis, ad suturam adpressis et irregulariter sub-crenulatis; costellis parum obliquis, irregularibus: aperturá pyriformi, dimidium totius testæ in longitudinem feré æquanti, margine externo undato.

Var. ABBREVIATA. Fig. 1 *i—k*. *A. testá ventricosiori, breviori; anfractibus quinque, convexioribus; aperturá longiori, spiram in longitudinem superanti.*

Shell oval-oblong, with a somewhat acute apex; the six volutions, of which the spire is formed, are more or less convex in different individuals, and are longitudinally ribbed; the edges are slightly pressed against the preceding volution, so as to present a narrow band running round the spire, parallel with the suture; the ribs are rounded, irregular, rather oblique, and slightly thickened above the sutural band, giving a rough crenulated appearance to the edges of the volutions; they are crossed, saltierwise, by very faint obscure lines of growth, perceptible only in well-preserved specimens. The aperture is pear-shaped, and about half as long as the entire shell; the outer lip undulated. The truncation of the columella, a character which the imperfect state of the specimens figured by Mr. Sowerby did not enable him to detect, places the shells, described by that author as *Limnea maxima* and *Bulimus costellatus*, in the present genus. The volutions are variable, being in some specimens less convex than in others; and the aperture in the young state is comparatively longer than that of the mature shell. A similar change in the relative proportions of the spire and the aperture at different stages of growth is not of infrequent occurrence, and is exhibited in some of the recent species in this genus, particularly in *Achat. striata*, (*Glandina truncata*, Pfeiffer.) These considerations, confirmed by the examination of a long series of shells of the present species in different stages of growth, have induced me to consider *Bul. costellatus* as merely the young form of the shell figured as *Limnea maxima*. The more regularly conical form of the spire, the only distinction by which the former is separable from the latter, is mainly due to the preservation of the shell in the specimen figured, and is a character which cannot be relied upon.

The present species belongs to the group constituting the genus *Glandina*, and is another instance of the approximation of an European Eocene land Mollusc to the living forms of the Western world.

Size.—Axis $2\frac{1}{4}$ inches, nearly; diameter 9-10ths of an inch.

The specimen represented by figs. 1 *i* and 1 *k*, resembles the type in the crenulated

edges, and costellation of the volutions, in the shape of the aperture, and in the character of the columella; and I consider it, therefore, as merely a variety. It is a ventricose shell, with a shorter spire, and more convex whorls; the aperture is longer in proportion, exceeding the spire in length, owing probably to the shell not having attained maturity. The specimen, the only one I have seen, belongs to Mr. D'Urban's collection.

Size.—Axis 1 inch and 6-10ths; diameter, 1 inch, nearly.

Localities.—Sconce, Shalcombe, Binstead, Isle of Wight.

Genus 9th. PUPA.* *Lamarck*. 1801.

COCHLODONTA, (sp.), *Férussac*.

COCHLODINA, (sp.), *Férussac*.

COCHLOGENA, (sp.), *Férussac*.

Gen. Char.—Shell cylindrical, elongated, or sub-globose; apex generally obtuse, sometimes acuminate; whorls numerous, slowly increasing, the last smaller than the penultimate one; frequently striated or ribbed; aperture generally elliptical, sometimes sub-quadrate in front, and rounded behind; peritreme continuous, slightly incrassated and reflected; outer lip dentated; teeth variable in number; one or two plaits on the columella.

The present genus is one of the dismemberments effected by Lamarck of Bruguière's genus *Helix*. The organisation of the animal bears a strong general resemblance to that of the animals of *Helix* and *Bulimus*; and Férussac has reunited the genus to *Helix*, in which it is distributed among the sub-genera *Cochlodonta*, *Cochlodina*, and *Cochlogena*. The shell, however, prevents striking dissimilarities, and in the animal, according to M. Deshayes, the same modifications of the generative organs occur which distinguish the animal of *Bulimus*. The elongated cylindrical form of the spire, the proportion of the last whorl to the penultimate one, and the direction of the aperture which is parallel with the axis, distinguish the shell from *Helix*; and it is separated from *Bulimus* by the numerous and slowly increasing volutions, and by the teeth and folds with which the outer lip and the columella are furnished. It is to *Clausilia* that it bears the closest resemblance; but from that genus it is separated as well by the aperture as by the absence of the clausium, a character which, however, can seldom be available to the Palæontologist.

In the animals of several of the smaller species the peduncles only exist, the tentacles becoming obsolete. Some of these species are sinistral and hyaline, and form Müller's genus *Vertigo*. The animal, however, exactly resembles *Pupa* in everything but the absence of the tentacles, and, inasmuch as their disappearance is very gradual

* Etym., from a supposed resemblance to the Pupa or Chrysalis of some insects.

in the smaller species, M. Deshayes attributes but trifling value to that character, and proposes to suppress the genus altogether.

The living species are very numerous and widely disseminated, but the larger ones are confined apparently to tropical climates.

The fossil species are few; one species (*Pupa Defranci*) is described by Brogniart from the Freshwater deposits of the Paris basin. Bouillet, in his catalogue of the fossil shells of Auvergne, gives two others referred to recent species; and Matheron describes two more species from the South of France, one from the Freshwater formation at Baux, and the other from the middle beds of the lignite formation near Rognac.

No. 26. PUPA PERDENTATA. *F. E. Edwards*. Tab. XI, fig. 7 *a—e*.

P. testá cylindricá; apice . . . ? anfractibus planulatis, longitudinaliter costellatis, ad basin sub-angulatis; costellis acutis, numerosis, irregularibus, undulosis, parum obliquis; aperturá sub-quadrátá, multis lamellis inequalibus, penitissimé decurrentibus, utroque margine instructá.

The imperfect state of my specimens, which are merely casts, will not enable me to do much more than to record the existence of this well-marked species. The dentition they present rather belongs to *Clausilia* than to *Pupa*; but as this is a dextral shell, and all the known *Clausiliæ* are sinistral, I refer it to the present genus. I possess six or seven specimens only, all without the apex, and the largest showing only the last three whorls. The characters, so far as they can be given from these fragments, are as follows:—Shell cylindrical, apparently elongated, and composed of many whorls; the whorls nearly straight, longitudinally costellated, and bluntly angulated at the base; the costellæ sharp, oblique, numerous, irregular, undulating, and separated by deep rounded sulci, and here and there one of them terminates abruptly, being cut short by the confluence of the sulci. The aperture, owing to the angular base of the body-whorl, assumes a subquadrate, or rather a lozenge shape; the outer lip presents no less than fourteen lamelliform teeth, six of which are large, having smaller teeth between them; the columellar lip is armed with three large lamelliform teeth, and four smaller. These teeth are not merely marginal, as is usually the case in this genus, but are continued, like those of *Clausilia*, far back into the whorls.

Size.—Axis . . . ? diameter, 2-10ths of an inch nearly.

Locality.—Sconce, where it is very rare.

No. 27. PUPA ORYZA. *F. E. Edwards*. Tab. XIV, fig. 3 *a—b*.

P. testá parvá, ovato-cylindracedá, ad utramque extremitatem equaliter attenuatá; apice sub-obtuso; anfractibus octonis, convexiusculis, longitudinaliter tenuissime costellatis; suturis profundis; aperturá ovato-oblongá, angustá, obliquá, quaternis dentibus magnis instructá.

A small cylindrical oval shell, tapering equally towards both extremities; the apex is rather blunt; the whorls, which are eight in number, are slightly convex, separated by a deep conspicuous suture, and transversely costellated; the costellæ are numerous, very slender, and oblique. The aperture is ovate-oblong, narrow, and somewhat oblique; the outer lip is furnished with four prominent lamelliform teeth, of which the two anterior are the longest.

I possess only one specimen, a cast, of this species; and the state of the aperture does not enable me to say whether the columellar lip is furnished with teeth. The species appears to be perfectly distinct.

Size.—Axis 2 lines; diameter 1 line.

Locality.—Headon Hill.

Genus 10th. CLAUSILIA.* *Draparnaud*. 1805.

Gen. Char.—Shell sinistral, cylindrical, elongated, consisting of numerous volutions, generally transversely striated; rather blunt at the apex, and enlarged towards the middle; aperture irregular, oval; peristome continuous, free, reflected, with several columellar and other tooth-like plaits, and furnished with an appendage, termed the *clausium*, attached to the columella, by which the aperture is partially closed when the animal is withdrawn into the shell.

The *clausium*, from which the present genus derives its name, answers the purpose of an operculum, with which, however, it presents no further analogy than that it serves to enclose and protect the animal within the shell. It consists of a narrow, flat, and very thin calcareous pedicle attached by the posterior extremity to the columella, and expanding at the opposite end into a linguiform plate, which nearly closes the aperture of the penultimate whorl, a small canal across the anterior part of the aperture being left uncovered, probably for the purpose of respiration. In some species when the outer lip presents teeth, the *clausium* is notched for their reception. This curious appendage is formed when the animal approaches maturity, probably at the same time with the projected reflected mouth. The pedicle is very flexible, and yields to the

* Etym. *Clausium*, (quasi *clausus*, closed, or *claustrum*, a door,) the appendage by means of which the animal is enclosed in the shell.

slightest pressure, as the animal emerges from the shell, and the clausium is then bent back against, and fits upon, the curved columella, but recovers its former position by the recoil of the pedicle on the removal of the pressure when the animal withdraws itself into the shell. This peculiar appendage was described first by D'Aubenton, and subsequently by Müller; and the group of shells characterised by its presence was formed by Draparnaud into the present genus.*

The animal of *Clausilia*, so far as its organisation is known, resembles that of Pupa, but Lamarck considered that the differences in the form and condition of the aperture to which I have already referred, were in themselves sufficient for generic distinction without reference to the presence of the clausium. On the other hand, Férussac has placed *Clausilia* in his genus *Helix*, where it forms part of his sub-genus *Cochlodina*; and M. Deshayes has been induced, by the resemblance between the external characters of the animals, by the similarity of their habits, and by the gradual passage from the one genus to the other by intermediate species, to propose the union of the two genera. Unless, however, peculiarity of structure or form in the shell is to be altogether disregarded, the presence of so singular an appendage as the *Clausium* must surely be considered as sufficient ground for the separation of this genus.

Nearly two hundred living species, mostly small shells, are known; several are found in this country, but they occur in great profusion in Southern Europe; the larger species belong to tropical climates.

Only three fossil species I believe have as yet been described; viz., *C. antiqua*, from the Freshwater limestone of Ulm; *C. maxima*, from the neighbourhood of Dax, and *C. campanica*, from the Freshwater limestone of Provins, in which the Paleotherian remains occur.

No. 28. *CLAUSILIA STRIATULA*. *F. E. Edwards*. Tab. XI, fig. 6 a—h.

Cl. testá subturritá, cylindracea, ad utramque extremitatem attenuatá, transversim lineatá: anfractibus numerosis, plano-convexis, ultimo ad basin porrecto; aperturá ovato-pyriformi, obliquá; peristomate soluto, parum reflexo: lamellis quinque, duobus margine externo, tribus margine columellari, instructo.

A cylindrical, subturreted shell, attenuated at each extremity; the whorls are very slightly convex, and covered with numerous rather oblique raised lines, separated by broad rounded sulci, occasionally confluent; the last whorl detaches itself, and projects obliquely forward, terminating in an ovate, pyriform aperture, the margins of which are free, and a little reflected. The outer lip presents two unequal plait-like teeth, the smaller one near the middle, the larger one near the posterior angle of the

* A particular account of the Clausium has been given by Mr. Miller, in the 'Annals of Philosophy,' vol. iii, p. 378; and by Mr. J. E. Gray, in the 'Zoological Journal,' vol. i, p. 212.

aperture. On the columellar lip are three similar teeth, one, very large, close to the columella.

I have not been so fortunate as to meet with any specimen having more than fragments of the shell preserved; the description therefore is principally taken from casts. The chief characters presented by them, namely, the large pliciform teeth and the produced aperture, are, however, plainly shown. The specimen represented by figs. 6 *a* and 6 *b* is, I apprehend, the young shell.

Size.—My most perfect specimen of the mature shell has apparently lost the upper six or seven whorls; in its present state it presents six whorls only. The length of the axis is 6-10ths of an inch, nearly; the diameter 2-10ths, nearly. In a perfect state it was probably nearly an inch long.

Locality.—Sconce, where it is very rare.

Genus 11th. SUCCINEA.* *Draparnaud*. 1801.

AMPHIBULIMA, *Lamarck*, 1805; *Hartm.*, 1821.

AMPHIBULIMUS, *Montf.*, 1810.

COCHLOHYDRA, *Férus.*, 1819.

Gen. Char.—Shell ovate, or ovately conical, rather elongate; volutions few; spire short, pointed; aperture large, entire, longitudinally ovate, oblique; peristome sharp, not thickened nor reflected, and confluent with the columella; inner lip spread over a part of the body whorl; columella smooth, sharp-edged, with an imperforated axis.

This genus, first created by Draparnaud, has been received without question by all Malacologists except Férussac, with whom it forms the sub-genus *Cochlohydra* in his extensive genus *Helix*. The animals, like all others of this family, present a strong general resemblance to the typical *Helix*; but, according to M. Deshayes, they offer modifications of the generative organs, which differ alike from those of *Helix* and of *Bulimus*. Lamarck, in ignorance of Draparnaud's genus, proposed his genus *Amphibulima*, which he afterwards suppressed, adopting the name given by Draparnaud. The shells are distinguished from *Bulimus* by the thin outer lip, and the rapidly enlarging whorls; and from *Limnæa*, to which they more nearly approach in general form, by the columella, which is thin, smooth, and sharp, and destitute of the oblique fold which characterises the columella of the latter genus.

The *Succineæ* are strictly land animals; for, although frequently covered by water and capable of long submersion, they live habitually on land in damp marshy places, near the margins of pools or ditches.

The living species are not numerous, and are found chiefly in temperate climates.

* Etym., *Succineus*, of amber, *i. e.*, amber-coloured.

The fossil species are very few. Two only have hitherto been described; both from the Pleiocene formations, and both referred to living forms, viz., *S. putris* and *S. oblonga*, from the Mammaliferous Crag, (Wood's 'Crag. Moll.,' p. 5). The latter species is also given by M. Nyst, ('Coq. Foss. de Belg.,' p. 446,) as occurring in the corresponding formation in Belgium.

No. 29. *SUCCINEA IMPERSPICUA*. *S. Wood*. Tab. XI, fig. 3 *a—d*.

S. IMPERSPICUA, *S. Wood*. 1847. Lond. Geol. Jour., vol. i, p. 118.

S. testá ovatá, ventricosá, tenui, lævi; spirá brevissimá, obtusá: anfractibus tribus, convexis, ad suturam sub-depressis: aperturá rotundato-ovatá, sub-verticali, bessem totius testæ in longitudinem superanti.

This exceedingly rare shell is thin, smooth, ovate, and composed of three ventricose volutions, rather depressed at the suture. The spire is very short and obtuse; the aperture large, nearly vertical, and in length fully equal to two thirds of the whole shell.

I have three specimens only of this shell: two from Hordwell, for which I am indebted to Mr. S. Wood; the third is from Headon Hill.

Size.—Axis rather more than 2-10ths of an inch; diameter, 3-10ths of an inch.

Section β . *Aquatica*, Fleming.

LIMNOPHILA, *Hartm.*

HYGROPHILA, *Féruss.*

Family—LIMNÆIDÆ.

Genus 12th. LIMNÆA.* *Lamarck*.

BUCCINUM, (sp.) *Müller*, 1774.

BULIMUS, (sp.) *Scopoli*, 1777; *Bruguère*, 1792.

LYMNEA, *Lamarck*, 1801; *Risso*, 1826; *Valenc.*, 1833.

LIMNEUS, *Draparnaud*, 1805; *Brogniart*, 1810.

LYMNEUS, *Brard*, 1809; *D'Orb.*, 1841.

LYMNUS, *Montfort*, 1810.

LIMNÆA, *De Férussac*, 1821; *Nillson*, 1822; *Grateloup*, 1838; *Bronn*, 1838.

LIMNÆUS, *Oken*, 1815; *Rossmasler*, 1835; *Turton*, 1831.

STAGNICOLA, *Leach*, 1820.

GULNARIA, *Leach*, 1820.

* Etym., Λιμναῖος, belonging to, or growing in, pools or marshes.

LYMNEA, *J. Sowerby*, 1818; *De Blainville*, 1825; *Desmarest*.

LIMNEA, *G. Sowerby*, 1822; *Fleming*, 1828; *G. Sowerby, Jun.*, 1840.

— *Swainson*, 1837.

LEPTOLIMNEA, *Swainson*, 1840.

LYMNOPHYSA, *Fitzinger*, 1833.

LYMNULA, *Rafinesque*, 1819.

Gen. Char.—Shell ovate or elongated, frequently turreted, generally thin, smooth; spire always apparent, more or less elevated: volutions convex, somewhat depressed, sometimes ventricose, and rapidly enlarging; aperture large, entire, longitudinal, ovate, with a tortuous columella bearing an oblique fold; peristome sharp edged.

The shells forming this genus, constituted part of the genus *Bulinus* of Scopoli and of Bruguière; they had previously been separated by Müller from the other land and freshwater Molluscs under the generic name *Buccinum*, applied to them by Lister and Geoffroy. In lieu of this name, which has been applied by Linnæus to a group of marine branchiate Molluscs, Lamarck substituted that of *Lymnea*, etymologically Limnæa.

The animal carries on its head two compressed triangular tentacles, enlarged at their bases, at the inner and anterior parts of which the eyes are placed. Like most others of this order, the *Limnææ* are hermaphrodite, and although the union of two individuals is necessary for fecundation, as among the *Helicidæ*, yet impregnation is not mutual, as in that group; but the same animal performs the male and female functions successively with different individuals.

The genus, as at present defined, is composed exclusively of the thick dextral shells, with a fold on the columella, in which the inner lip is not extended over the body whorl; the genus *Amphipeplea*, (Nilsson, the MS. genus *Myxas* of Dr. Leach,) having been proposed for the dextral forms with a plaited columella, in which the shell is thin and polished, and the inner lip expanded. The sinistral forms, without the columellar fold, have been separated under the generic names *Physa* (Draparnaud), and *Aplexus* (Fleming), the *Bulinus* of Adanson. The propriety of these subdivisions is questioned by Mr. G. Sowerby in his 'Genera of Shells;' but, besides the conchological differences above mentioned, there are zoological distinctions which are generally admitted as sufficient grounds for retaining them. These are, in *Physa* and *Amphipeplea*, the condition of the mantle, the edge of which is lobed and capable of extension, so as to cover the shell, which thence acquires the polished and shining surface characteristic of those genera; and the form of the tentacles, which are elongated and filiform, and not thick and triangular, as in the present genus. In *Aplexus* the edge of the mantle is, as in *Limnæa*, simple and not extendible over the shell; that genus, therefore, bears the same relation to *Physa* which *Limnæa* bears to *Amphipeplea*.*

* The propriety of these divisions is, to some extent, confirmed by the observations of Mr. W. Thompson, to which I have before referred. That author, speaking of the dentition in the different genera of the Pulmonata, states that "the character of *Limnæus* appears to be to have one small central tubercle, as it were,

The Limnææ are inhabitants of freshwater streams and pools, and occasionally of brackish marshes. The living species are found in all parts of the world, but principally in the temperate zones. In the fossil state, species have been found in the Wealden formations; and they occur in great profusion in the freshwater deposits of the Eocene epoch, and, in greater or less abundance, in nearly all the lacustrine formations above those deposits. In England, as in the Paris basin, the fossil Limnææ occur in very different conditions in the various deposits; in the limestone of the lower formation, called, from the abundance of their remains, the "Limnæan Limestone," specimens with the shell preserved are very rare; generally only the casts are found, the shelly matter having been absorbed. In the upper marls they occur in great profusion, and, although very fragile, usually in a beautiful state of preservation.

It is exceedingly difficult, as both Lamarck and De Blainville have observed, to distinguish the different species; the length of the spire, the contour of the volutions, and the size and shape of the aperture, characters by which species may be separated with tolerable certainty, in other genera, are, in this genus, exceedingly variable, and glide by imperceptible gradations from one extreme to another; so that reliance cannot be implicitly placed on them. The character which appears to exhibit the least variation is the columellar fold, although this also occasionally presents considerable differences in form and condition. By this character, however, the genus may be divided into two groups, one comprising the species in which the fold is flattened; the other consisting of the species in which it is rounded or sub-acute. Each of these groups may, again, be subdivided into two sections, according as the upper parts of the whorls, forming the sides of the spire, are convex or flat. By the use of these artificial distinctions, the separation of the species will be much facilitated.

Sect. *a*. Columellar fold compressed, generally bipartite.

No. 30. LIMNÆA CAUDATA. *F. E. Edwards*. Tab. XII, fig. 2 *a—c*.

L. testá ovato-acutá, ventricosá, lævi: anfractibus numerosis, convexiusculis, ultimo penultimoque rapidè crescentibus: ultimo obsoletè et irregulariter corrugato: spirá conico-

'squeezed up' between two very large lateral ones, each primary lateral having a very large apex internally, with a small external one, while, at the edge, they have altered to one thick prolonged apex projecting inwards, and irregularly lobed on its upper edge. Much the same arrangement prevails in *Amphipeplea*, where, however, the tubercle of the lateral teeth is even still larger in proportion to its plate. *Physa*, again, exhibits a multitude of teeth of a similar form, though different to any that I have seen in other genera." The dentition of *Aplexus* is not described.

subulatá: aperturá magná, in medio dilatátá, anticè coarctatá, spiram in longitudinem superanti: plicá columellari compressá, proeminenti, valde obliquatá, obscurè sulcatá.

Var. ABBREVIATA; testá anfractibus septem vel octo; spirá breviori; aperturá longiori.

Shell ovate-acute, ventricose, smooth, composed of eight or nine convex volutions, of which the first five or six increase slowly, and the last enlarge rapidly; so that the spire assumes a conical awl-like shape, while the body-whorl is very ventricose. The last two volutions frequently present concentric, obscure, irregular corrugations, giving a crumpled appearance to the shell, similar to that which distinguishes the recent *L. stagnalis*. The aperture is large, effuse towards the middle, but contracted at the anterior part, and somewhat larger than the spire. The columellar fold is flat, prominent, rather strongly twisted, and generally obscurely sulcated.

A variety occurs (fig. 2 c) in which the shell is more ventricose, the whorls fewer, the spire shorter, and the aperture proportionally larger, equalling two thirds of the whole shell.

The *L. caudata*, in its general appearance and awl-like spire, much resembles *L. stagnalis*; but, in the latter species, the whorls are more convex, the body-whorl more ventricose, the posterior part of the aperture more effuse, and the columellar fold is rounded, smaller, and more oblique. Individuals occasionally occur which, from the small degree of convexity in the whorls would, at the first glance, be referred to *L. fusiformis*; but they may be easily separated by the columellar fold, which, in the latter species, is rounded, and presents a more graceful spiral than that of *L. caudata*.

Size.—Axis $2\frac{1}{4}$ inch, nearly; diameter 1 inch.

Localities.—Hordwell Cliff and Headon Hill.

No. 31. *LIMNÆA PYRAMIDALIS*. *Desh.* Tab. XIII, figs. 2 a—b, and 3 a—b.

LIMNÆA PYRAMIDALIS. *Desh.* 1824—37. Desc. des coq. foss., &c., vol. ii, p. 95, t. 20, figs. 14, 15.

LIMNÆA „ *J. Sow.* 1825. Min. Con., vol. vi, p. 54, t. 528, fig. 3.

LIMNÆA „ *Bouill.* 1836. Catal., des coq. foss. de l'Auvergne, p. 124.

LYMNÉE PYRAMIDALE? *Brard.* 1810. Ann. du Mus., vol. xv, p. 407, t. 24, fig. 2.

LYMNEUS PYRAMIDALIS? *Fér.* 1814. Mém. geol., &c., p. 60, No. 3.

L. testá ovato-acutá, ventricosá, lævi; anfractibus septem vel octo convexis: aperturá magná, anticè dilatátá, spiram in longitudinem superanti; labio parum expanso; columellá marginatá; plicá columellari magná, compressá, obliquá, in medio sub-bipartitá.

A smooth, ovate-acute, ventricose shell, composed of seven or eight convex whorls, separated by a simple, well-defined, but not deep suture: the aperture, which is fully as long as the spire, is large and effuse; the inner lip but slightly spread over the body-whorl, and the columella presents a margin formed by the thickened inner lip, and bears a prominent oblique fold, obscurely sulcated.

The whorls enlarge more regularly in this species than in *L. caudata*, and the shell, consequently, is more pyramidal in its general form; and the columellar fold is not so prominent nor so much twisted as in that species. From *L. fusiformis* it is distinguished by the greater convexity of the whorls, and the flattened sulcated fold. The rounder whorls, the depression of the upper margin, and the acute fold of *L. cincta*, separate it, as clearly, from that species.

Although M. Deshayes, in his description of *L. pyramidalis*, cites Brard without comment, I feel great difficulty in referring his shell to Brard's *L. pyramidalis*. That shell, judging from the description and figure, is elongated and narrow, and corresponds, as well in the contour and proportion of the whorls and the form of the aperture, as in the character of the depressed columellar fold, with *L. longiscata*, to which species I think it belongs. It certainly appears to differ widely from the ventricose and comparatively short shell described by M. Deshayes, in which the aperture is large and effuse, and the fold prominent.* The English specimens referred to *L. pyramidalis* of M. Deshayes, agree very well with that author's description and figure, but not with Brard's; while, on the other hand, adult specimens of *L. longiscata* frequently occur, which correspond with Brard's *L. pyramidalis*.

The shell represented by fig. 3 *a—b*, for the use of which I am indebted to Mr. Sowerby, is narrower than the type of this species; and the volutions are so flat, and the general shape so fusiform, that, at first sight, it might be referred to *L. fusiformis*. The fold, however, is flattened and sulcated; and I therefore consider it to be merely an aberrant form of *L. pyramidalis*, combining the columellar fold of that species with the flat-sided spire and subfusiform shape of *L. fusiformis*.

Size.—Axis 2 inches; diameter, 9-10ths of an inch, nearly.

Localities.—Hordwell; Headon Hill; and in France, La Villette, Montmartre, and Vergnols, near Aurillac.

No. 32. LIMNÆA LONGISCATA. Brard. Tab. XII, fig. 3 *a—h*.

LYMNÉE EFFILÉE. Brard. 1809. Ann. du Mus., vol. xiv, p. 432, t. 27, figs. 15, 16.

— PYRAMIDALE, Brard (?) 1810. Ib., vol. xv, p. 407, t. 24, fig. 2.

LIMNEUS LONGISCATUS, Brogn. 1810. Ib., p. 372, t. 22, fig. 9.

— — Brogn. 1811. Jour. de Phys., &c., vol. 72, p. 421.

LIMNEUS LONGISCATUS, Fér. 1814. Mém. géol., &c., p. 59, No. 1.

LIMNEA LONGISCATA, Sow. 1823. Min. Con., vol. iv, p. 57, t. 343.

LYMNÆA — Desh. 1824. Desc. des coq. foss., &c., vol. ii, p. 92, t. 11, figs. 3, 4.

— — Desh. 1824. Encycl. Meth. Vers., t. 2, p. 356, No. 1.

* This want of resemblance between the *L. pyramidalis* of M. Deshayes and that of Brard is noticed by Bouillet in his Catalogue above referred to.

- LIMNEA LONGISCATA, *Lyell and Murch.* 1829. Mém. sur les dépôts lacustres tert. du Cantal.
- LIMNÆA — *Bouill.* 1836. Cat. des coq. foss., &c., p. 157, No. 6.
- — *Gratel.* 1838. Cat. des débris foss., &c., du Bassin de la Gironde, p. 33, No. 100.
- LYMNÆA — *Desh.* 1838. Lam. Hist. Nat. &c., 2d edit., vol. viii, p. 422, No. 7.

L. testá lævi, elongatá, sub-turritá, acuminatá: anfractibus sex aut septem, convexiusculis; suturis sub-depressis: aperturá ovato-acutá, anticè dilatatá, spiram in longitudinem vix æquanti; labro parum expanso; columellá marginatá; plicá columellari latá, compressá, parum eminenti, bipartitá.

Var. DISTORTA; testá longiori, angustiori, anfractibus plus decurrentibus; aperturá breviori.

This *Limnæa* is more abundant, and, although it presents many varieties of form, is, perhaps, better characterised than any other fossil species. It is a smooth, elongated, narrow, subturrit shell, composed of seven or eight convex whorls, somewhat depressed at the suture. The aperture is oval, rather effuse in front, and, in the typical form, is a little shorter than the spire; the inner lip is thick, but does not extend much beyond the aperture. The columellar fold is broad, flat, not very prominent, and widely but not deeply sulcated.

A variety frequently occurs (fig. 3 *e—h*), in which the line of the suture runs below the wide part of the whorl, giving an irregular distorted appearance to the shell, and shortening the aperture, the length of which barely equals two fifths of the whole shell.

Although there can be but little doubt that this is the true *Lymnée effilée* of Brard, the columellar fold does not correspond with the description given by M. Deshayes, in which it is represented to be small and rounded; but in the few French specimens which I have had an opportunity of examining, the columellar fold corresponds with that of the English specimens. I presume, therefore, that the form described by M. Deshayes was a modification of the more general form.

The shell figured and described by Brard as *L. pyramidalis*, appears to me, as I have already stated, from its elongated narrow shape, the form of the aperture, and the slight elevation of the fold, to be merely an adult specimen of this species—similar to that represented by fig. 3 *c* and *d*. The “double suture,” or “narrow spiral riband,” running along the edge of the suture, which Brard mentions as distinguishing *L. pyramidalis*, frequently occurs in this, as well as in other species; it is not, however, a constant character in any, and cannot be relied upon as a specific distinction.

A form occurs, rather plentifully, in Hordwell Cliff, which Mr. Wood (‘Lond. Geol. Journ.’ vol. i, p. 118,) has referred to *L. strigosa*, (Brogn.) That species, apparently, was proposed from casts or mutilated specimens, and is a questionable

one; M. Deshayes, in fact, ('Descr. des Coq. Foss.,' &c. vol. ii, p. 92,) has suggested that it may be merely a variety of *L. longiscata*. The Hordwell shells, like the French, are shorter, and the whorls are more convex; but they present the characteristic fold of the present species, of which I consider them to be, therefore, only a variety.

Size.—Axis, 2 inches; diameter, 8-10ths of an inch.

Localities.—Hordwell; Headon Hill; Sconce. *French*: Belleville; Saint-Ouen; Fontainebleau; Rochechouart; Veurs, and Vergnols, near Aurillac; Dax.

No. 33. *LIMNÆA SULCATA*. *F. E. Edwards*. Tab. XIV, fig. 4 *a—b*.

L. testá ovatá; anfractibus quinque vel sex, convexiusculis, substriatis; spirá mediocri, acutá; aperturá ovatá, spiram in longitudinem superanti; margine externo parum obliquo; plicá columellari compressá, vix eminenti, profundè sulcatá.

An ovate shell, composed of five or six slightly convex whorls on which the lines of growth are very conspicuous, imparting a sub-striated appearance to the surface; the spire moderately elevated and pointed. The aperture is ovate, and rather longer than the spire; the outer lip but slightly oblique, and the columellar fold compressed, not very prominent, and more deeply sulcated than in any other species.

In general appearance this species resembles *L. arenularia*; but it may be distinguished by the flat and deeply sulcated fold.

Size.—Axis, rather more than 1 inch; diameter $\frac{1}{2}$ an inch.

Localities.—Hordwell; Headon Hill.

No. 34. *LIMNÆA GIBBOSULA*. *F. E. Edwards*. Tab. XIV, fig. 8—*c*.

L. testá ovatá, sub-turritá; spirá brevi, sub-acutá; anfractibus sex, gibbosulis, ultimo magno, suturis profundis: aperturá acuto-semi-ovali, amplá, basi effusá, bessem totius testæ in longitudinem superanti; labro reflexo; plicá columellari parvá, parum tortuosá, sub-compressá, obscurè sulcatá.

An ovate sub-turreted shell, with a moderately elevated and rather obtuse spire; volutions six, somewhat gibbous, separated by a deep suture, and, in some specimens, flattened round the upper margin; the last volution is proportionally large. The aperture is semi-oval, dilated in front, acute behind, and exceeds in length two thirds of the whole shell; the inner lip is reflected; the columellar fold small, somewhat compressed, not much twisted, and obscurely sulcated.

This species resembles *L. subblata* more than any other; but the shell is larger, the spire not so much elevated, the volutions more equally gibbous, the aperture much longer and more effuse at the base, the fold not so much twisted and the outer

lip not so oblique. From *L. tumida* it is separated by the shorter spire and the flat sulcated columella.

Size.—Axis, 1 inch and 7-10ths; diameter, 9-10ths of an inch nearly.

Locality.—Headon Hill.

No. 35. *LIMNÆA SUBLATA*. *F. E. Edwards*. Tab. XIII, fig. 4 *a—b*.

L. testā ovato-acutā, ventricosā: anfractibus sex, convexis, lævibus; aperturā rotundato-semi-ovali, per-obliquā, amplā, spiram in longitudinem paulo superanti; margine externo reflexiusculo; plicā columellari compressiusculā, angustā, parum eminenti, valde tortuosā.

A smooth, ventricose shell, with a moderately elevated spire, and an acute apex: the six whorls of which it is formed are convex, and separated by a conspicuous but not deep suture; the aperture is roundedly semi-oval, effuse, and a little longer than the spire. The outer lip is very oblique, and slightly reflected; the inner one scarcely extends beyond the aperture; the columella is much twisted, and the small narrow fold is compressed and very little prominent.

Owing to the great obliquity of the aperture, the shell must have been carried by the animal with the spire more raised than is usually the case in this genus; from this peculiarity the specific name has been taken.

The present species approaches nearly to *L. gibbosula*, but the spire is longer and more pointed, the whorls more ventricose, and the aperture shorter in proportion, and more oblique. The greater convexity of the whorls, the shorter spire, the narrow, slightly projecting fold, and the effuse and oblique aperture, distinguish it from *L. pyramidalis*. It appears to be rare.

Size.—Axis $1\frac{1}{2}$ inch; diameter 8-10ths of an inch.

Locality.—Headon Hill.

No. 36. *LIMNÆA MIXTA*. *F. E. Edwards*. Tab. XIII, fig. 5 *a—b*.

L. testā ovato-acutā; spirā elevatā; anfractibus sex vel septem, convexiusculis, longitudinaliter striatis, ultimo magno, sub-ventricoso: aperturā ovali, anticè coarctatā, bessem totius testæ in longitudinem ferè æquanti; plicā columellari sub-rectā, angustā, compressiusculā, parum eminenti, obscure sulcatā.

An ovate shell, with a moderately elevated pointed spire; volutions six or seven, slightly convex, almost flat on the upper parts composing the sides of the spire, and marked more strongly than usual in this genus by conspicuous irregular lines of growth; the body whorl large and rather ventricose. The aperture is oval, contracted in front, and, in length, nearly equal to two thirds of the whole shell; the columellar fold is very little twisted, narrow, slightly flattened, barely prominent, and obscurely sulcated.

I propose this species with hesitation ; it may be only a variety of *L. pyramidalis* or of *L. gibbosula*, but the characters it presents are so mixed, that it is difficult to determine to which species it should be referred. The narrow, flat, and nearly straight fold resembles very closely that of *L. gibbosula* ; but the spire is more elevated, more pyramidal, the volutions more regularly convex, and the aperture not so effuse. It is distinguished from the typical *L. pyramidalis*, not only by the columellar fold, which in the latter species is larger, more oblique, and more prominent, but also by the flatness of the sides of the spire, and the greater length of the aperture ; and from the variety of that species, by the more contracted aperture. In the character of the spire, and the contracted aperture, it approaches *L. fusiformis* ; but it is separated from it by the columellar fold, which in that species is rounded, prominent, and more twisted.

Size.—Axis, 1 inch and 6-10ths ; diameter, 8-10ths of an inch.

Locality.—Headon Hill.

No. 37. LIMNÆA OVUM? Brogn. Tab. XIV, fig. 12 a—b.

LIMNEUS OVUM, Brogn. 1810. Ann. du Mus., vol. xv, p. 374, tab. 22, fig. 13 A, B.

— — Brogn. 1811. Journ. de Phys., &c., p. 422.

LYMNEUS — Féru. 1814. Mém. geol., &c., p. 60, No. 6.

LYMNÆA — Desh. 1824—37. Desc. des coq. foss., &c., vol. ii, p. 97, tab. 11, figs. 15, 16.

— — Desh. Encyc. Méth. Vers., vol. ii, p. 361, No. 16.

— — Bouill. 1836. Cat. des coq. foss. d'Auv., p. 131, No. 13.

L. testá ovali, sub-ventricosá, acuminatá, sub-lævi; anfractibus sex, convexis, ultimo magno: aperturá mediocri, ad basin sub-dilatatá; columellá marginatá; plicá columellari parvá, compressá, sulcatá, anticé angulatá, parum tortuosá.

As I have not had an opportunity of comparing the English with French specimens of this species, the identification cannot be altogether free from doubt. The English shell is nearly smooth, ovate, and sub-ventricose, with a moderately elevated and pointed spire ; volutions six or seven, separated by a conspicuous but not deep suture. The aperture is not wide, but is a little dilated in front, and is about half the length of the entire shell : the columellar fold is small, compressed, obscurely sulcated, very slightly twisted, and scarcely projects into the aperture ; the anterior margin presents an acute ridge, formed by the prolongation of the sharp edge of the peristome ; the inner lip is slightly reflected.

The aperture is not so contracted in front as M. Deshayes describes that of the French shell to be ; it agrees very well with Brogniart's figure, but not with that given by M. Deshayes, although the latter was taken from Brogniart's specimen. In other respects the English shells do not appear to differ from the French.

In the general contour, and in the proportions of the aperture, the present species closely resembles *L. convexa*; but the small, flat, sulcated fold separates it from that species.

Size.—Axis, 1 inch and 3-10ths; diameter, rather more than 6-10ths of an inch.

Localities.—Headon Hill. *French*: Pierrelaie.

Sect. *b*. Columellar fold rounded or sub-acute.

No. 38. *LIMNÆA FUSIFORMIS*. *J. Sowerby*. Tab. XIII, fig. 8 *a—g*.

LYMNÆA FUSIFORMIS, *J. Sow.* 1818. Min. Con., vol. ii, p. 155, tab. 169, figs. 2-3.

LIMNÆA — *G. Sow.* Genera of Shells.

— — *Lyell and Murch.* 1829. Sur les dépôts lacustres, &c., du Cantal.

L. testá ovato-acutá, sub-fusiformi, lævi; anfractibus septenis vel octonis, sub-planis, ultimo ventricoso: aperturá ovatá, spiram in longitudinem vix æquanti; columellá marginatá; plicá columellari rotundatá aut sub-acutá, parum tortuosá.

Var. DEFORMIS, (fig. 8 *c—e*), *testá breviori; anfractibus sex vel septem, ventricosioribus: aperturá rotundato-ovali, spiram in longitudinem superanti; plicá columellari rotundatá, eminentiori.*

A smooth ovate-acute shell, formed of seven or eight whorls, the upper sides of which are nearly straight, giving a regular conical form to the spire, which is elevated and pointed; the last whorl is ventricose; the lines of growth conspicuous and sharp. The aperture is ovate, moderately large, and nearly as long as the spire; occasionally the anterior part is somewhat contracted, imparting a sub-fusiform shape to the shell. The columellar fold is thick, and, generally, rounded; but sometimes it presents a rather sharp anterior margin; it is slightly and gracefully twisted.

Of this species, as of *L. caudata*, a variety occurs (fig. 8 *c—e*) in which the shell is much shorter, the volutions very ventricose, the aperture roundedly ovate, and the fold rounded and prominent.

The contraction of the anterior part of the aperture, causing the fusiform shape to which Mr. Sowerby refers, frequently occurs, but it is not by any means a constant character; in fact, the aperture is more generally somewhat effuse, as represented in the figure 8.

This species approaches *L. pyramidalis* more nearly than any other of the fossil *Limnææ*; but the flatness of the sides of the spire, and the rounded fold, are characters by which it may easily be distinguished. The variety resembles the short variety of *L. caudata*; but the whorls are more ventricose, and the fold is not compressed and sulcated, as in that species.

Size.—Axis, 2 inches nearly; diameter, 8-10ths of an inch.

Localities.—Hordwell, Headon Hill, Sconce. *French*: Aurillac in the Cantal.

No. 39. LIMNÆA TUMIDA. *F. E. Edwards.* Tab. XIII, fig. 6 *a—b*.

L. testá ovato-acutá, ventricosá, sexies vel septies circumvolutá; spirá elevatá, apice acuminato; anfractibus convexis, ultimo tumido: aperturá ovatá, amplá, bessem totius testæ in longitudinem fere æquanti; margine columellari reflexo; plicá parum tortuosá, eminenti, rotundatá, in medio sub-callosá.

An ovate, ventricose shell, with an elevated, pointed, rather subulate, spire; volutions six or seven, the early ones increasing in size slowly, the last two more rapidly; the upper parts forming the sides of the spire are rather flattened, as in *L. pyramidalis*; the body whorl large and tumid. The aperture is ovate, and in length nearly equal to two thirds of the whole shell; the anterior margin, where it joins the columella, is slightly reflected; the columella itself is not much twisted, and the fold is prominent, round, and thickened towards the middle.

This species may be distinguished from *L. gibbosula*, by the round columellar fold and longer spire; and from *L. fusiformis*, by the more convex volutions, the tumid body whorl, the longer aperture, and the nearly straight fold.

Size.—Axis, 1 inch and 8-10ths nearly; diameter, 11-10ths of an inch.

Locality.—Headdon Hill.

No. 40. LIMNÆA COLUMELLARIS. *J. Sowerby.* Tab. XIII, fig. 9 *a—b*.

LIMNÆA COLUMELLARIS, *Sow.* 1826. Min. Con., vol. vi, p. 53, t. 528, fig. 2.

— — ? *Lyell and Mur.* 1829. Sur les dépôts lacustres, &c., du Cantal.

L. testá ovato-ventricosá, sub-turritá, quinquies vel sexies circumvolutá; spirá brevi, apice acuto; aperturá ovali, dilatatá, bessem totius testæ in longitudinem fere æquanti; plicá columellari rotundatá, callosá, valde contortá, pro-eminenti.

I am indebted to Mr. Sowerby for the use of the original specimen described by him of this species. It is a ventricose, oval shell, with a short pointed spire, and formed of five or six very convex whorls, rather depressed at the suture, whence the shell presents a subturreted appearance; the aperture is large, effuse, and nearly as long as two thirds of the whole shell; the thick, callous-like fold is round, very prominent, and much twisted.

If it were not for the convexity of the whorls and the size of the aperture, I should be inclined to consider this shell to be only a variety of *L. fusiformis*; and that the unusual contortion of the fold, a character to which individuals of that species occasionally approach very nearly, is accidental. But in this species, the pyramidal shape, which always distinguishes the spire of *L. fusiformis*, is altogether wanting. From *L. tumida*, which it resembles in the size of the aperture, it is also separated by the

greater flatness of the sides of the spire and the less prominent and less oblique fold of that species. It appears to be very scarce.

Size.—Axis, rather more than 1 inch ; diameter, $\frac{1}{2}$ an inch.

Locality. Hordwell. *French*: Aurillac in the Cantal.

No. 41. *LIMNÆA SUB-QUADRATA*. *F. E. Edwards*. Tab. XIII, fig. 1 *a—b*.

L. testá ovato-oblongá, turritá, lævi; spirá mediocri, apice acuto: anfractibus sex aut septem plano-convexis: aperturá ovatá, anticé dilatátá, spiram in longitudinem superanti; labio incrassato reflexo; columellá subrectá, plicá parvá, vix eminenti, sub-acutá.

Shell ovate, oblong, turreted, smooth, with six or seven rather flatly-convex volutions; spire moderately elevated, with an acute apex; aperture ovate, somewhat effuse in front, and rather more than half the length of the whole shell; the inner lip thickened, and a little reflected; the columella nearly straight, and presenting a small, rather sharp fold, which scarcely projects into the aperture.

The turreted and depressedly convex form of the whorls gives a sub-quadrate appearance to this shell, by which, as well as by its nearly straight columella, and sharp and barely prominent fold, it may be distinguished from *L. convexa*, which it most nearly resembles.

Size.—Axis, rather more than $1\frac{1}{2}$ inch ; diameter, 8-10ths of an inch.

Locality.—Headon Hill.

No. 42. *LIMNÆA CONVEXA*. *F. E. Edwards*. Tab. XIII, fig. 7 *a—b*.

L. testá ovato-ventricosá, sexies circumvolutá; anfractibus convexis, lævibus; spirá elevatá, apice sub-acuto: aperturá ovatá, anticé effusá, spiram in longitudinem superanti; labio reflexo; plicá columellari pro-eminenti, tortuosá, rotundatá.

An ovate ventricose shell, formed of six smooth convex volutions, with a moderately elevated and pointed spire: aperture ovate, effuse in front, and rather longer than the spire; the inner lip slightly reflected; the columellar fold round, prominent, and very oblique.

This species somewhat resembles *L. sub-quadrate*; the whorls, however, are more regularly convex, and do not present the turreted appearance which characterises that shell; and the round columellar fold is much more prominent, and more strongly twisted. In the convexity of the whorls it approaches *L. pyramidalis*, but the flat sulcated fold separates that species from this.

Size.—Axis, 1 inch and 3-10ths; diameter, 6-10ths of an inch.

Locality.—Headon Hill. In Mr. D'Urban's collection.

No. 43. LIMNÆA COSTELLATA. *F. E. Edwards.* Tab. XIII, fig. 10 *a—b*.

L. testá ovato-ventricosá, sub-turritá; spirá mediocri, acuminatá; anfractibus quinque vel sex, convexis, longitudinaliter sub-costellatis, et lineis incrementi subtilissimé striatis; costellis obscuris, irregularibus, remotiusculis: aperturá ovatá, amplá, spiram in longitudinem superanti; labio reflexo; plicá columellari vix tortuosá, rotundatá, parum eminenti.

The striated *Limnææ* generally acquire that character from the conspicuous lines of growth; but the present species presents obscure costellæ, as well as the striation due to the lines of growth. It is an oval, ventricose, sub-turreted shell, with a moderately elevated spire and pointed apex, and formed of five or six convex volutions, very finely striated by the lines of growth, and also longitudinally costellated; the costellæ are obscure, irregular, and separated by broad shallow sulci, in which the lines of growth are perceptible. The aperture is ovate, rather dilated, and a little longer than the spire; the columellar margin strongly reflected, and the fold rounded, slightly twisted, and but little prominent.

Independently of its costellated character, this species presents differences which prevent its being confounded either with *L. strigosa* (Brogn.), or *L. substriata* (Desh.). In the first species, the shell is more elongated, the aperture smaller, and the columellar fold resembles that of *L. longiscata*, of which I think it is merely a variety; in the latter, the spire is more elevated, the aperture much contracted in front, and altogether narrower; and the fold is prominent and strongly twisted.

The present appears to be a well-marked species.

Size.—Axis, rather more than 1 inch; diameter, 4-10ths of an inch.

Localities.—Hordwell; Headon Hill.

No. 44. LIMNÆA FABULUM. *Brogniart.* Tab. XIV, fig. 10 *a—b*.

- LIMNEUS FABULUM. *Brogn.* 1810. Ann. du Mus., vol. xv, p. 375, t. 22, fig. 16.
 — — *Brogn.* 1811. Journ. de Phys., &c. vol. lxxii, p. 423.
 LYMNEUS — *Fér.* 1814. Mém. geol., p. 61, No. 13.
 LIMNEA — ? *Lyell and Murc.* 1829. Sur les dépôts lacust. tert. du Cantal.
 LYMNEA FABULA. *Desh.* 1824—37. Desc. des coq. foss., &c., vol. ii, p. 96; t. 11, figs. 11-12.
 — — *Desh.* 1830. Ency. Méth. Vers., vol. ii, p. 361.
 LYMNEUS FABULUM. *Defr.* 1835. Dict. des Sci. Nat., vol. xxvi, p. 462.
 LIMNEA FABULA. *Nyst.* 1836. Rech. coq. foss. de Hoesselt, &c., p. 20, No. 49.
 LYMNEA FABULA. *Desh.* 1838. 2d edit. Lam. Hist. Nat., vol. viii, p. 223, No. 9.
 LIMNEUS FABULA? *Nyst.* 1843. Desc. des coq. &c. foss. des Terr. tert. de Belg., p. 469, t. 38, fig. 18.

L. testá ovato-ventricosá, lævi, acuminatá; anfractibus quinque vel sex, convexiusculis: aperturá ovato-acutá; plicá columellari sub-acutá, parum tortuosá.

A smooth, ovate, ventricose shell, with a short pointed spire, and formed of five or six slightly convex whorls; the aperture pointedly ovate, and the columellar fold somewhat angular and prominent, but not much twisted.

I have not had an opportunity of comparing the English with the French shells, and I have therefore some hesitation in pronouncing as to their identity. My specimens, however, agree very well with the description and figures given by M. Deshayes, (which it must be remembered are taken from casts merely,) except that the French shell is described as formed of four whorls only, and as having the aperture contracted at the base; but the figures show six whorls, and the aperture, as drawn, is scarcely more contracted than that of the English shell.

Size.—Axis, rather more than 8-10ths of an inch; diameter, 4-10ths of an inch.

Localities.—Hordwell. *French*: Jouy; Saint-Prix, Montmorency; Pierrelaie and Lavergnol in the Cantal. *Belgian*: Kleyn-Spauwen.

NO. 45. *LIMNÆA CINCTA*. *F. E. Edwards*. Tab. XIV, fig. 5 *a—b*.

L. testā elongato-ovatā, sub-turritā, sexies vel septies circumvolutā; spirā exsertā, acuminatā; anfractibus convexis, substriatis: aperturā rotundato-ovatā, amplā, spiram in longitudinem æquantī; plicā columellari parvā, angustā, rotundatā, parum tortuosā, proeminenti.

An elongated ovate shell, with an elevated pointed spire; volutions six or seven, very convex, almost ventricose, the edges of which are depressed along the suture, and, generally, present a sharp stria running round them, parallel with and at a short distance below the suture,—similar to that mentioned by Brard as characterising his *L. pyramidale*: the lines of growth are so strongly marked that the surface of the shell almost appears to be striated. The aperture is roundedly ovate, somewhat effuse, and barely exceeds the spire in length; the columellar fold is narrow, rounded, not much twisted, and prominent.

The line of suture frequently runs below the wide part of the whorl, giving a distorted appearance, resembling that which is sometimes seen in *L. longiscata*, and in fact the present shell presents a close analogy with that species. It is, however, distinguished from *L. longiscata*, as well as from *L. pyramidalis* (Desh.), by the round columellar fold, and the greater convexity of the whorls.

Size.—Axis, $1\frac{1}{2}$ inch; diameter, rather more than $\frac{1}{2}$ an inch.

Locality.—Headon Hill.

No. 46. LIMNÆA ANGUSTA. *F. E. Edwards*. Tab. XIV, fig. 6 *a—b*.

L. testá angustá, elongatá, sub-turritá, quinquies vel sexies circumvolutá; spirá elevatá, acuminatá; anfractibus convexis, lineis incrementi obscuré striatis: aperturá ovato-oblongá, anticé sub-dilatatá, spiram in longitudinem parum superanti; plicá columellari crassá, tereti, parum eminenti, sub-tortuosá.

If it were not for the thick, round, columellar fold, and the elongated aperture, I should refer this species to *L. longiscata*, which it much resembles. It is a narrow, elongated, sub-turreted shell, formed of five or six convex volutions, obscurely striated by the lines of growth; the spire elevated and pointed. The aperture is a longish oval, equal to half the length of the shell, and rather spread out in front; the columellar fold is thick, round, not very prominent, and but slightly twisted.

The long narrow shape of this shell separates it from every species except *L. longiscata*; from the latter shell it is easily distinguished by the fold, so opposite in character to the broad, flat, sulcated fold which characterises that species.

Size.—Axis, $1\frac{1}{4}$ inch; diameter, not quite $\frac{1}{2}$ an inch.

Localities.—Hordwell; Headon Hill.

No. 47. LIMNÆA ARENULARIA. *Brard*. Tab. XIV, fig. 13 *a—b*.

LYMNÉE DES GRES. *Brard*. 1810. Ann. du Mus., vol. xv, p. 409, t. 24, fig. 5-6.

LYMNEUS ARENULARIUS. *Féruss*. 1814. Mém. geol. &c. p. 61, No. 15.

LYMNÆA ARENULARIA. *Desh*. 1824—37. Desc. des coq. foss., &c., vol. ii., p. 93, t. 11, figs. 7-8.

L. testá ovato-acuminatá, sub-turritá, lævi; anfractibus septenis, convexiusculis, suturis conspicuis: aperturá amplá, semi-ovali, spiram in longitudinem superanti; plicá columellari rotundatá, minimá, parum contortá, sub-proeminenti.

A smooth, ovate, oblong sub-turreted shell, with a moderately elevated and taper spire; volutions seven or eight, slightly convex, separated by a conspicuous, but not deep, suture, and occasionally striated by faint lines of growth: the aperture rather large, semi-oval, a little dilated in front, and longer than the spire; the columellar fold rounded, small, slightly twisted, and not very prominent.

The English shells correspond so nearly with M. Deshayes's figures, and with some French specimens, for which I am indebted to that gentleman, as not to leave any doubt as to this identification, notwithstanding that M. Deshayes describes the aperture as very oblique, and the columellar fold as much twisted, characters which I have not found prominent either in the English or French specimens.

Size.—Axis, 4-10ths of an inch; diameter, 7-20ths of an inch.

Localities.—Hordwell; Headon Hill. *French*: Beauchamp, near Pointoise, Valmondois.

No. 48. LIMNÆA MINIMA. *Sowerby*. Tab. XIV, fig. 9 *a—c*.

LIMNÆA MINIMA. *Sow.* 1817. *Min. Con.* vol. ii, p. 156, t. 169, fig. 1.

L. testá minimá, ovato-elongatá, lævi; anfractibus quinque aut sex, convexiusculis: aperturá ovali, spiram in longitudinem vix æquanti; margine columellari reflexo; plicá sub-rectá, rotundatá, parum eminenti.

It is not unlikely that this, as Mr. Sowerby has suggested, may be the young shell of some species already described, probably of *L. arenularia*, to which, in its regularly taper spire and rounded fold, it presents a close approximation. It is a very small, smooth, elongated, ovate shell, with five or six rather convex volutions, separated by a moderately deep suture: the aperture is ovate, and rather less than half the length of the entire shell; the inner lip is strongly reflected, and the fold is round, nearly straight, and very little prominent.

The figures are taken from the original specimen described by Mr. Sowerby in 'Mineral Conchology.'

Size.—Axis, 3-10ths of an inch nearly; diameter, 2-10ths nearly.

Locality.—Headon Hill.

No. 49. LIMNÆA RECTA. *F. E. Edwards*. Tab. XIV, fig. 7 *a—b*.

L. testá ovato-ventricosá, sub-turritá; spirá mediocri, apice acuto; anfractibus sex aut septem, convexis: aperturá ovali, amplá, anticé dilatatá, longiori quam spira; margine columellari sub-reflexo; plicá parvâ, vix tortuosâ, parum eminenti.

The convexity of the whorls, the pointed spire, and the nearly straight rounded fold, distinguish this from every other fossil species. It is a short ovate shell, with a moderately elevated spire, and an acute apex; volutions six or seven, very convex, the last one rather ventricose: the aperture large, of a roundedly ovate form, effuse in front, and longer than the spire; the inner lip slightly reflected, and the small rounded fold nearly straight, and scarcely impinging upon the aperture.

This shell much resembles *L. ovum* (Brogn.); but the volutions are fewer and more ventricose, and the aperture is more effuse. It does not appear to me to be referable to any other species; and I have therefore, although reluctantly, described it as a distinct species.

Size.—Axis, 1 inch and 1-10th; diameter, 5-10ths of an inch.

Locality.—Headon Hill.

No. 50. LIMNÆA TENUIS. *F. E. Edwards.* Tab. XIV, fig. 11 *a—b*.

L. testā tenui, ovato-ventricosā, sub-turritā; anfractibus sex, convexis, ultimo magno; apice acuto: aperturā ovatā, effusā, in longitudinem bessem totius testæ feré æquanti; plicā columellari brevi, angustā, rotundatā, parum tortuosā.

This species presents so close an analogy with *L. tumida*, that it would be difficult to separate the two, if it were not for the great difference in size. The shell is very thin, ovate, and formed of six convex volutions, depressed round the suture, which character imparts to it a sub-turreted appearance; the spire is somewhat elevated and pointed; the body-whorl large and ventricose: the aperture ovate, effuse, and nearly as long as two thirds of the entire shell; the columellar fold short, narrow, rounded, and not much twisted.

Size.—Axis, 8-10ths of an inch; diameter, 4-10ths of an inch.

Locality.—Headon Hill.

Genus 13th. PLANORBIS. *Geoffroy.*

CORETUS, *Adanson*, 1757.

PLANORBIS, *Geoffroy*, 1767; *Guettard*, 1770; *Müller*, 1773-4.

Gen. Char.—Shell discoidal, spire depressed; volutions apparent above and below, convoluted upon a nearly horizontal plane, thin, generally smooth, ventricose, sometimes carinated: aperture simple, lunate, crescent-shaped or sub-quadrate, impinged upon by the preceding volution; outer lip generally thin, sharp edged, sometimes thickened or reflected; columellar lip slightly spreading over the body whorl. No operculum.

The animals belonging to this genus were placed by Linnæus among the Helices; they had, however, been separated, as a distinct group, by Lister, nearly a century previously, and formed the third section of the Lacustrine shells of that author. Shortly before the publication of the *Systema Naturæ*, Adanson described a small species to which he gave the generic name *Coretus*. The genus was afterwards defined by Geoffroy under the present name *Planorbis*; and Müller, to whom it has been generally attributed, only adopted Geoffroy's name.

The animal of *Planorbis* is elongated, slender, and strongly rolled up; the head is furnished with two long contractile tentacles, at the internal bases of which the eyes are placed; the orifices are on the left side; the organs of generation distinct.

Whether the shell of *Planorbis* is dextral or sinistral is a question which has been much discussed, and, by some authors, is considered as still undecided. By Linnæus, Müller, and subsequent writers to the time of Cuvier, it was regarded as dextral, and was described as *supra umbilicata*. The transposition in *P. corneus* of the

orifices and the heart, all of which are on the side contrary to that in which they are placed in the animals of dextral shells, induced Cuvier to consider that species as sinistral: and in this opinion many eminent naturalists have concurred. M. Desmoulins, however, has ascertained, by a careful anatomy of the animal of *P. corneus*, that, although the orifices and the heart have an abnormal position, the organs of digestion and generation, in fact, retain the position they hold in dextral molluscs; and that author, therefore, maintains that nearly all the known species of *Planorbis*, as well living as fossil, are dextral. M. Deshayes concurs in this opinion; and, after remarking that the upper side may be distinguished from the under side by the obliquity of the aperture, the superior margin of which is more produced, cites the observations of M. Desmoulins as explaining the apparent anomaly of a sinistral animal in a dextral shell, and how, in reality, the animal is dextral as well as the shell; there not being any other derangement in the relation of its organs than with regard to the heart and the termination of the digestive and generative organs. With regard to the shell, it will be seen at once, on observing the manner in which it is carried by the animal, that it is dextral, and that, as Mr. Benson has stated,* if it be viewed practically as sinistral, and placed as such, the animal will be on its back, and will have to twist its body half round in order to gain the ground with its foot. Mr. Benson, therefore, proposes to consider that face as containing the apex, in discoidal shells, which is contiguous to the back of the animal; and, he adds, this side may invariably be known in *Planorbis* by the greater projection of the lip in that part, by the deeper depression of the central umbilicus, and by the more considerable involutions of the whorls occasioning a greater depth of suture. Mr. G. Sowerby, on the other hand, asserts† that the shell is sinistral, and that it is only needful to observe on which side of the shell the very apex of the spire is actually to be seen, and, taking that side for the upper, in conformity with the strict rules of analogy, it will immediately be evident that the aperture is on the left side. This criterion, however, is seldom available; for, in general, the apex is concealed by the involution of the whorls, and the shell presents, on each face, what may be easily mistaken for an umbilicus; and the difficulty in determining which face contains the apex, and which the true umbilicus, is not removed. It is well known that testaceous molluscs, when placed in conditions unfavorable to healthy development, frequently depart from their normal form; and that their shells, in consequence, are distorted, and become what are usually called monstrosities. Thus, in *Planorbis*, the animal, under such conditions, frequently loses, to a greater or less degree, its strong convolution on a horizontal plane; and the shell assumes, in conformity, a more or less elongated spiral form, with an elevated apex. M. Desmoulins cites these monstrosities in support of his opinion, observing that, when they occur, the whorls gradually glide from left to right, down the imaginary

* Journal Asiat. Soc. Bengal, vol. v, p. 744.

† Genera of Shells. Gen. *Planorbis*.

axis. A series of such distorted specimens of *P. complanatus*, taken from a pond near Swansea, formed, I believe, by the waste water from a steam-engine, and of a high temperature, is in the British Museum. These specimens have all assumed an elevated spiral form; and the aperture is in every case dextral. Several specimens of *P. vortex*, in Mr. Sowerby's Museum, are similarly distorted; and in them also the apertures are dextral. On the whole, the better opinion appears to be that the shell, as well as the animal, is dextral, notwithstanding the abnormal position of the heart and the orifices; and in the following descriptions, therefore, I have considered the shell as dextral, and I have applied the term *upper* to that disc which is uppermost when the shell is placed with the mouth on the right side of the spectator, and the term *under* to the opposite disc.

The *Planorbes* live in fresh water; more frequently in stagnant water or standing pools, although, occasionally, they are found in gentle streams. They are widely diffused, but abound principally in temperate climates. I believe that at present there is not any species known as living in salt or brackish waters; and the specimens found in the crag formation, and described by Mr. Wood, are referred to recent species which are known to be pure fresh-water animals; and these shells are therefore considered to have been accidentally introduced.

Four species also occur in the estuarine or fluvio-marine deposits of the Eocene epoch: viz., *P. hemistoma* (Sow.); *P. obtusus* (Sow.); *P. biangulatus* (nov. spec.); and *P. elegans* (nov. spec.); but, like the crag specimens, they have, probably, been deposited there by the agency of some river: they all occur in the pure fresh-water or the transition formations.

Fossil species are numerous, but they abound principally in the formations of the tertiary epoch; Prof. E. Forbes, however, states, (Brit. Mol., vol. iii, p. 146,) that representatives of the genus, differing but slightly from species still living, are found in fresh-water strata of even the oolitic epoch.

No. 51. PLANORBIS EUOMPHALUS. Sowerby. Tab. XV, fig. 6 a—c.

PLANORBIS EUOMPHALUS.	J. Sowerby.	Min. Con., vol. ii, p. 92, t. 140, figs. 7—9.
—	—	G. Sowerby. Genera of Shells, fig. 5.
—	—	Deshayes. Lam. Hist. Nat., 2d edit., vol. viii, p. 397, No. 9.

P. testá supra sub-planá, ad peripheriam angulatá, subtus latè et profundè cavatá; anfractibus sex, sub-trigonis, vix involventibus, transversim lineis incrementi notatis, aliquandoque concentricè striatis; subtús ad marginem umbilicalem obtusè angulatis; striis concentricis numerosis, irregularibus: aperturá per-obliquá.

This well-known species, which at present appears to be confined to the fresh-water formations of England, is easily distinguished from the other fossil *Planorbes*. It is a large discoidal shell, nearly flat on the upper face, and presenting a wide and

deep umbilical cavity beneath; the six or seven volutions of which the shell is formed, are flat, or nearly so, above; convex below; and each but slightly embracing the preceding volution; the apex is concealed by the involution of the whorls. A clearly defined and rather acute angle, almost forming a keel, runs round the periphery of the shell, and separates the upper from the under disc. This angle is always very conspicuous in young shells; but as they approach maturity, it becomes more and more obtuse, and frequently altogether disappears; the whorls then assume a transversely oval form, approaching nearly to that presented by *P. rotundatus*. On the under surface, the inner margins of the whorls are bent rather suddenly towards the preceding whorl, and present, in consequence, an obtuse angle, which runs round and defines the umbilicus. Transverse lines of growth are very conspicuous; and frequently the surface of the shell also presents more or less numerous concentric raised lines, some of which are larger and more prominent than the rest. The aperture is sub-trigonal, slightly impinged upon by the preceding volution, and very oblique.

This species presents a general resemblance to *P. rotundatus*; but, even when the characteristic angle has become obsolete, it may easily be distinguished by the greater breadth, and the flatness of the upper surfaces, of the whorls, the much larger concavity on the under side of the shell, and the subtrigonal and more oblique aperture. From *P. discus* it is separated by the more compressed form of that species, caused by the greater width of the whorls, and the comparative flatness of their under sides; and in that species the whorls are more embracing than in this.

Size.—Diameter, 1 inch and 6-10ths.

Localities.—Headon Hill; Hordwell.

No. 52. *PLANORBIS ROTUNDATUS*. *Brard*. Tab. XV, fig. 4 *a—c*.

PLANORBE ARRONDI. *Brard*. 1809. Ann. du Mus., vol. xiv, p. 433, t. 27, figs. 19, 20.

PLANORBIS ROTUNDATUS, *Brogn.* 1810. *Ib.*, vol. xv, p. 370, t. 22, figs. 4, 5.

— — — *Ib.* 1811. Jour. de Phys., vol. lxxii, p. 419, figs. 4, 5.

— *SIMILIS*. *Fér.* 1814. Mém. geol., p. 61, No. 1.

— *ROTUNDATUS*. *Fér.* 1814. *Ib.*, No. 2, var. A.

— — — *Desh.* 1824—37. Desc. des coq. foss., vol. i, p. 83, t. 9, figs. 7, 8.

— — — *Desh.* 1824—37. Encycl. Meth. Vers., &c., vol. iii, p. 778, No. 2.

— — — *Bowd.* Elem. of Conch., t. iv, fig. 7.

— — — *Lyell and Mur.* 1829. Sur les dépôts, &c. du Cantal.

— — — *Bouillet.* Desc. hist. et scient. de la Haute Auver., p. 18, figs. 6, 7.

— — — *Ib.* 1836. Cat. des coq. viv. et foss. de l'Auver., p. 115, No. 2.

— — — *Gratel.* 1838. Cat. des deb. foss., &c., du bassin de la Gironde, p. 33, No. 102.

— — — *Desh.* 1838. Lam. Hist. Nat., 2d edit., vol. viii, p. 394, No. 1.

P. testá lævi sub-striatáve, supernè sub-planá, subtus concavá; anfractibus sex vel septem, rotundatis, vix involventibus, infernè ad marginem umbilicalem sub-angulatis; suturis profundis: aperturá parum obliquá.

A rather large shell, formed of six or seven nearly round volutions, separated by a deep suture, and each slightly impinged upon by the preceding one; the volutions are flatly convex on the upper sides, convex beneath, and, like those of *P. euomphalus*, present an angle running round the inner margins near the umbilicus, which, as the shell approaches maturity, becomes almost obsolete. The upper face is nearly flat; while the under side presents a moderately deep and wide concavity. The aperture is transversely oval, and but slightly oblique. The striæ of growth are very conspicuous; and occasionally, although very rarely, the shells present fine concentric lines, similar to those which characterise *P. euomphalus*; in this species, however, the lines are finer and more crowded, and seldom extend beyond the first three or four volutions.

Brard states that, in *P. arrondi*, the whorls are perfectly round, and do not impinge upon the succeeding whorls; and in these respects his shell does not agree with the English specimens; but the figures, apparently, are taken from a cast, and the disagreement may probably be attributed to that circumstance. Brogniart's fig. 4, (var. A, of that author,) agrees very well with our specimens, except that the aperture is more oblique. In the figure given by M. Deshayes, the whorls are wider and more flattened on the upper surface, and the upper margin of the aperture appears to be more produced than in any English specimen I have seen; the shell, too, is larger than our shells, and, in fact, strongly resembles those specimens of *P. euomphalus* in which the characteristic angle round the whorls has become obsolete.

The general resemblance and the distinctions between the present species and the recent *P. corneus*, have been pointed out by the French authors cited; and, on comparing the two, it will be seen that in the latter species the whorls are fewer, rounder, and enlarge more rapidly, and that in consequence, the shell is deeper and more largely umbilicated than the fossil species.

MM. Férussac and Deshayes mention a variety (probably the var. B of Brogniart) in which the shell is smaller, rather more compressed, and nearly equally concave above and below; I have not met with this variety among the English specimens.

Size.—Diameter, 1 inch and 2-10ths.

Localities.—*English*: Sconce; Headon Hill; Hordwell. *French*: Aurillac, La Vissiere, Lavergnol, in the Cantal; Saint-Prix; Palaiseau, Milon near Versailles; Triel; Fontainebleau; La Villette.

No. 53. *PLANORBIS OBTUSUS*. Sowerby. Tab. XV, fig. 1 *a—e*.

PLANORBIS OBTUSUS. Sow. 1818. Min. Con., vol. ii, p. 91, t. 110, fig. 3.

P. testá depressá, lævi; supernè convexiusculá, subtús concavá: anfractibus quinis, obtusé-ovalibus, sese partim involventibus; suturis profundis: aperturá per-obliquá, obcordatá.

This very pretty shell has a smooth, shining, nearly polished surface; it is depressed, nearly flat on the upper side, and moderately concave beneath. The volutions are five, separated by a deep suture, slightly convex on both faces, but rather more compressed on the under side than on the upper, obtusely rounded at the periphery, and each nearly half concealed by the succeeding volution. The aperture is very oblique and bluntly heart-shaped.

In the general form and rounded whorls, this species much resembles *P. sparnacensis* (Desh.), but the whorls are not so numerous, and the aperture is more oblique. The lenticular form and angulated margin of *P. lens*, will prevent its being confounded with that species.

Size.—Diameter, 7-10ths of an inch.

Localities.—Sconce; Headon Hill; Upper mar., Hordwell.

No. 54. *PLANORBIS DISCUS*. F. E. Edwards. Tab. XV, fig. 7 *a—d*.

P. testá valde compressá, quinquies circumvolutá, supernè planá, subtus profundè cavatá: anfractibus sex, rapidè crescentibus, parum involventibus, subtus convexiusculis, ad marginem umbilicalem angulatis: aperturá per-obliquá, elongato-cordatá.

This well-marked species appears to be peculiar to the fresh-water formation at Sconce. It is a much compressed discoidal shell, nearly flat on the upper side and deeply hollowed out below. The five or six whorls of which it is formed enlarge rapidly, and each is slightly embraced by the succeeding one; they are much flattened above, slightly convex below, and obtusely rounded at the outer edge. In the young state, the inner margin is bent rather abruptly towards the preceding whorl, and presents an obtuse angle which defines the umbilicus, similar to that presented by *P. euomphalus* and *P. rotundatus*. As the shell approaches maturity, the under side assumes an almost regularly convex form, and the angle becomes obsolete. The aperture is very oblique, and of an elongated heart-shape.

The species which most resemble the present are *P. euomphalus* and *P. oligyratus*. From the first of these, it is distinguished by its more compressed discoidal form, and the rounded periphery. The whorls also enlarge more rapidly, and are consequently fewer and broader; and they embrace more of the preceding one than do those of *P. euomphalus*. The umbilical cavity also is not so wide. It is more difficult to

separate the present species, in the young state, from *P. oligyratus*; but, in the latter, the axis is longer, the whorls are more convex on the upper side, and the obtuse angle which runs round the periphery, near the upper surface, gives a subtrigonal form to the whorls and the aperture, quite distinct from the transversely oval form in the present species.

Casts of this *Planorbis* occur in great abundance, but specimens with the shell preserved are extremely rare.

Size.—Diameter, 1 inch and 6-10ths.

Locality.—Sconce.

No 55. *PLANORBIS OLIGYRATUS*. *F. E. Edwards*. Tab. XV, fig. 3 *a—e*.

P. testá supernè sub-planá, subtus cavatá: anfractibus quaternis, rapidè crescentibus, parum involventibus, ad peripheriam obtusè angulatis: subtus ad marginem umbilicalem angulatis: aperturá sub-trigoná, parum obliquá.

The present, like the preceding species, is apparently confined to the fresh-water formation at Sconce; but it is not so plentiful as *P. discus*. It is a moderately-sized shell, formed of four rapidly increasing whorls, somewhat convex above, and rather acutely angulated round the inner margins on the under side, just above the umbilicus. The periphery, near the upper surface, presents an obtuse angle, from which the whorls slope rather abruptly towards the umbilicus, assuming, in consequence, a subtrigonal form. The aperture is slightly oblique and bluntly obcordate, in consequence of its being impinged upon by the preceding whorl. The umbilical cavity is deep, but not very wide.

This species somewhat resembles the young shell of *P. discus*; but the greater convexity of the under side of the whorls, and the small degree of obliquity, and the shape of the aperture, will distinguish it. The adult shell of *P. discus* is easily separated by its greater size and compression.

The specimens ordinarily found are, like those of the preceding species, casts merely; with the shell preserved they are very rare.

Size.—Diameter, 7-10ths of an inch.

Locality.—Sconce.

No. 56. *PLANORBIS PLATYSTOMA*. *S. Wood*. Tab. XV, fig. 2 *a—d*.

PLANORBIS PLATYSTOMA. *S. Wood*. Lond. Geol. Journ., vol. i, p. 118.

P. testá parvá, utrinque fere equaliter cavatá; anfractibus trinis, rotundatis, tumidis, rapidè crescentibus, supra depressiusculis, subtus convexis, singulo fere dimidium antecedentis involventi: aperturá magná, per-obliquá, obtusè obcordatá, peristomate aliquando reflexo.

A small smooth shell, formed of three tumid rapidly-enlarging whorls, each embracing about one half of the preceding one; the whorls are rounded, almost equally convex above and below, but a little compressed on the upper side. The apex is wholly concealed by the involution of the whorls. The aperture is wide, very oblique, and bluntly heart-shaped; sometimes, in the adult shell, the peristome is reflected. The upper side is slightly concave, and the under side presents a wide and moderately deep umbilicus.

This species, which appears to have been first noticed by Mr. Wood, is so well marked that it cannot be confounded with any other. It somewhat resembles the young shell of *P. oligyratus*; but, in the latter shell, the whorls are not so embracing, the upper side is more flattened, and the under side is not so regularly convex. The aperture, also, is narrower and much less oblique. The reflected lip, which frequently occurs in the present species, evidences the maturity of the shell; and the difference between the size of such specimens and that of the fully formed shell of *P. oligyratus* confirms the separation of the two species. In addition to these distinctions, it may be stated that the present species is found plentifully both in Headon Hill and at Hordwell; but that as yet no specimen of *P. oligyratus* has been found at either of those localities.

Size.—Diameter 3-10ths of an inch.

Localities.—Hordwell; Headon Hill; and Sconce.

No. 57. *PLANORBIS LENS*. *Brogniart*. Tab. XV, fig. 8 *a*—*d*.

- PLANORBIS LENS*. *Brogn.* 1810. Ann. du Mus., vol. xv, p. 372, t. 22, fig. 9.
 — — *Ib.* 1811. Journ. de Phys., &c. vol. lxxii, p. 421.
 — — *Fér.* 1814. Mém. geol., p. 61, No. 10.
 — — *Sow.* 1818. Min. Con., vol. ii, p. 91, t. 140, fig. 4.
 — — *Desh.* 1824—37. Desc. des coq. foss., &c., vol. ii, p. 87, t. 9, figs. 11—13.
 — — *Bouill.* 1836. Catal. des coq. foss. de l'Auvergne, p. 115.
 — — *Desh.* Ency. Méth. Vers., &c., vol. iii, p. 783, No. 16.
 — — *Ib.* 1838. Lam. Hist. Nat., 2d edit., vol. viii, p. 396, No. 7.
 — — *Morris.* 1843. Cat. Brit. Foss., p. 156.

An. PLANORBE ANGULEUX? *Brard.* 1810. Ann. du Mus., vol. xiv, p. 435, t. 27, figs. 23-4.

P. testá parvá, lenticulari, levi, utrinque parum, sed plus superne quam subtus, cavatá; anfractibus quaternis, singulo fere dimidium antecedentis involventi; supra convexiusculis, subtus plano-convexis, ad peripheriam acutè angulatis; aperturá parum obliquá, elongato-cordatá.

Mr. Sowerby, when he gave the name *P. lens* to a British fossil, appears not to have been aware that that name had previously been dedicated by Brogniart to a shell from the Paris basin; but, by a singular coincidence, the shells described by

these authors appear to agree so closely that they must be referred to the same species. I have not, it is true, had an opportunity of comparing the English with the French shells; the identification, therefore, rests entirely on the figures and descriptions given by MM. Brogniart and Deshayes; but, forming my opinion from them, I cannot see any sufficient reason for considering the English shells as distinct. The present species is a small lenticular shell, slightly concave on each disc, but more so on the upper than on the under side: the whorls are four or five, each embracing nearly one half of the preceding whorl; they are slightly convex on both surfaces, but more so above than beneath, and acutely angulated round the periphery, a little below the middle of the whorl. The aperture is of an elongated heart-shape, and not very oblique.

Brogniart describes his shell as swelled out (*bombé*) and lenticular rather than umbilicated; and this, owing to the slight concavity of the discs, may be taken as the general character of the English shell. M. Deshayes, whose figures are drawn from the original specimen, states that in Brogniart's figure the shell is represented with the sides too much swelled out, and with the marginal angle too near the middle. Making due allowance for these errors, it will be seen that the contour of the shell and the form of the aperture represented by Brogniart's middle figure, agree very well with those of the English specimens.* In the figure given by Mr. Sowerby the aperture is represented as very obcordate, and it conveys the idea of the whorls and the shell being more convex than they really are. M. Bronn, in his '*Lethæa geognostica*,' (p. 1011,) states that the shell described by Mr. Sowerby is more depressed than that of the typical *P. lens*, and he refers it to a distinct species, which he has named *P. Sowerbyi*. I fear that M. Bronn had not authentic specimens of our *P. lens* before him; for the figures he has given (Tab. XL, fig. 17 *a—c*,) do not correctly represent that shell; but they, as well as his description, agree closely with another of our Eocene *Planorbes*, which I have therefore referred to his species. The *P. lens* of '*Mineral Conchology*' appears to me, as I have already stated, to correspond so closely with Brogniart's *P. lens*, that the two cannot be separated.

Férussac quotes Brard's *Planorbe anguleux* as a synonym; but whether the present species really is the same cannot well be determined without reference to the original specimen, as both the description and the figure given by Brard are too imperfect for the purpose of identification. I have, however, followed the example of MM. Brogniart and Deshayes, in quoting Brard with a query.

Size.—Diameter, 3-10ths of an inch nearly.

Localities.—Hordwell, and Headon Hill, where it is moderately plentiful. *French*: Saint-Chaumont, Pantin, Limagne, Cournon.

* Judging from the aperture, Brogniart's figures are reversed, probably owing to an oversight of the artist.

No. 58. *PLANORBIS TROPIS*. *F. E. Edwards*. Tab. XV, fig. 10 a—d.

P. testá minutá, depressá, lævi, superne parum concavá, subtus late umbilicatá: anfractibus quaternis vel quinis, lente crescentibus, supra convexiusculis, infra sub-planis, ad peripheriam carinatis, singulo dimidium antecedentis obtegenti: aperturá obliquá, angusticordatá.

Mr. Wood ('London Geol. Journ.,' vol. i, p. 118,) has referred this species to *P. planulatus* (Desh.), observing, however, that "the figure by Deshayes is not so flat and carinated as the English specimens, which more resemble the *P. exacutus* (Gould)." I have not seen any French specimens of *P. planulatus*; but, on comparing the English shells with the description and figures given by M. Deshayes, I cannot concur in referring them to that species. *P. tropis* is a minute, compressed, polished shell, a little sunk round the apex, and widely but not deeply umbilicated; the four or five volutions, of which it is formed, are slightly convex above, nearly flat beneath, and compressed near the outer margin so as to present a prominent keel, which runs round the periphery a little below the middle of the whorl. The whorls are much concealed, each embracing about one half of the preceding one; the aperture is very oblique and of a longish heart shape.

Although the general resemblance between this species and *P. planulatus* must be admitted, yet there are, I think, sufficient grounds for specific distinction. In the present species, the whorls increase more slowly and are more concealed; they are not so convex above nor so flat beneath, and, consequently, the keel is near the middle of the shell, and the aperture assumes an elongated heart shape; whereas, in *P. planulatus*, owing to the greater flatness of the under surface of the whorls, the marginal angle (for, judging from the figure given by M. Deshayes, the term *keel* is not applicable,) runs round the base of the shell, and the aperture is sub-trigonal. The English shell also appears to be smaller than the French one. On these grounds, notwithstanding the distrust I feel at dissenting from Mr. Wood's opinion, I consider the present to be a distinct species. In the character and position of the keel, *P. tropis* corresponds with *P. exacutus*; but in the recent shell, the whorls enlarge more rapidly and are more convex, both above and below; the umbilicus is deeper, and the aperture wider, than in the present species.

Size.—Diameter, not quite 3-20ths of an inch.

Locality.—Hordwell.

No. 50. *PLANORBIS HEMISTOMA*. *Sowerby*. Tab. XV, fig. 11 a—d.

PLANORBIS HEMISTOMA. *Sowerby*. 1818. Min. Conch., vol. ii, p. 91; t. 140, fig. 6.

P. testá minutá, depressá, lævi, superne profundé cavatá, subtus subplaná, ter quaterve circumvolutá; anfractibus vix involventibus, ad peripheriam sub-angulatis, supra convexi-

usculis, ad marginem sinistram acutè angulatis; infra subplanis; aperturá parum obliquá subtrigoná.

A minute, smooth, much depressed shell, deeply concave on the upper side, almost flat on the under side: volutions three or four, very slightly convex above, nearly flat beneath, and compressed, almost angulated at the periphery above the middle of the shell. The whorls can scarcely be described as embracing, inasmuch as the under surface is wholly exposed, although the upper surface is partly concealed by the succeeding whorl; the inner margin is bent, rather abruptly, towards the apex, and presents a conspicuous angle, which runs round the cavity. The aperture is oblique, but not much so, and subtrigonal, having the lower margin rounded.

This species somewhat resembles *P. elegans*; but it is smaller and more compressed, and the subangulated periphery and flatness of the whorls impart a triangular form to the aperture very different from the roundish, heart-shaped aperture of that species. In *P. biangulatus*, the whorls are more convex, and the aperture is consequently almost obcordate.

Size.—Diameter, 1-10th of an inch nearly.

Localities.—Hordwell; Plumstead; Sundridge; Rotherhithe.

NO. 60. *PLANORBIS ELEGANS*. *F. E. Edwards*. Tab. XV, fig. 12 *a—d*.

P. testá minutá, politá, superne profundè cavatá, subtus parum cavatá; quater vel quinquies circumvolutá, anfractibus lineis incrementi notatis, ad peripheriam rotundatis; supra convexis, ad marginem sinistram angulatis; infra convexiusculis; singulo fere trientem antecedentis obtegenti: aperturá parum obliquá, obcordatá.

This very elegant little *Planorbis* is found in great abundance on Headon Hill, in a deposit immediately above the upper fluvio-marine formation, associated with *Bulinus politus*, *Melanopsis carinatus*, *Melanopsis buccinoidea*, a species of *Neritina*, as yet undescribed, and *Melania muricata*. It is a small polished shell, deeply but not widely hollowed out on the upper disc, and slightly concave, almost flat, beneath: volutions four or five, rounded on the periphery, marked by conspicuous lines of growth nearly perpendicular to the axis, very convex, and presenting a sharpish angle running round the inner margin, on the upper surface, and but slightly convex beneath; each volution embraces nearly a third of the one preceding it. The aperture is of a roundish heart shape, and very slightly oblique.

Size.—Diameter, 3-20ths of an inch.

Localities.—The deposit in which this *Planorbis* principally occurs is a transition bed between the upper fluvio-marine and the pure fresh-water formations in Headon Hill. I have also found it, but very sparingly, in the upper fluvio-marine formation at Hordwell, and in the lower fluvio-marine or transition bed which intercalates the upper series of the true marine and the lower fresh-water formations at Mead End.

No. 61. *PLANORBIS BIANGULATUS*. *F. E. Edwards*. Tab. XV, fig. 13 *a—d*.

P. testá parvá, compressiusculá, utrinque parum, sed fere equaliter cavatá: anfractibus quinis, singulo antecedentem paucillulo involventi; supra convexis, ad marginem sinistram angulatis; subtus convexiusculis, ad marginem externam obscure crenulatis: aperturá irregulariter obcordatá, vix obliquá.

A small, somewhat depressed shell, slightly and nearly equally hollowed out on both sides, but rather more so above than beneath. It is formed of four or five volutions, convex on the upper side, and obtusely angulated round the cavity in consequence of the somewhat abrupt inflection of the inner margin toward the preceding volution; nearly flat on the under side, and obscurely crenulated near the outer margin. The periphery presents two angles; one, rather obscure, near the middle; the other, more prominent, runs round the margin of the lower disc. The aperture is slightly oblique, and of a short heart shape, but irregular in its form, owing to the greater convexity and the angulated inner margin of the upper surface of the whorl.

This appears to be a well-marked species; the double angle on the periphery and the crenulated under surface are characters which are not found in any other of the Eocene species.

Size.—Diameter, 2-10ths of an inch.

Localities.—Hordwell, as well in the pure fresh-water, as in the upper fluvio-marine formation; and at Mead End, in the lower fluvio-marine or transition bed before mentioned.

No. 62. *PLANORBIS SOWERBYI*. *Bronn*. Tab. XV, fig. 9 *a—d*.

PLANORBIS SOWERBYI. *Bronn*. 1838. *Lethæa geognost.*, p. 1011, t. xl, fig. 17 *a—c*.

P. testá parvá, depressá, utrinque parum et fere equaliter cavatá: anfractibus ternis vel quaternis, rapidè crescentibus; supra convexis, infra subplanis, ad peripheriam carinatis, singulo dimidium antecedentis obtegenti, cariná inferiori; aperturá elongato-cordatá, per-obliquá.

The present species appears to be rare. It is a small depressed shell, slightly and nearly equally hollowed out on both surfaces; but the umbilical cavity is the wider and deeper of the two. The volutions are three or four, enlarging rapidly, convex above, nearly flat beneath, and bearing a sharpish keel on the periphery, formed by the compression of the outer margins, a little below the middle of the shell. The whorls are much concealed, each embracing nearly half of the preceding one, and the aperture is very oblique, and of an elongated heart shape.

This shell appears to me, as I have already stated, to have been mistaken by M. Bronn for that described by Mr. Sowerby as *P. lens*, and to have been correctly

referred to a distinct species. It certainly presents a general resemblance to *P. lens*; but the upper side is more arched, the under side flatter, the whorls enlarge more rapidly, and the margins are more compressed and more acutely carinated than in that species; the umbilical cavity, also, is not so deep, and the aperture is of a more oblique and of a more elongated heart shape.

In the rapidly increasing size of the whorls and the condition of the marginal keel, the present species presents an analogy with the recent *P. exacutus* (Gould); but in the latter shell, the upper sides of the whorls are not concealed, the under sides are more convex, the umbilical cavity is deeper, and the aperture is almost obcordate. In *P. tropis* the shell is more compressed, the whorls enlarge more slowly, and the umbilical cavity is wider.

Size.—Diameter, 2-10ths of an inch.

Locality.—Sconce.

PLANORBIS CYLINDRICUS.—Mr. Sowerby has described a shell under this specific name, (Min. Conch., vol. ii, p. 90, t. 140, fig. 2,) the distinguishing characters of which are the vertically flattened, adpressed volutions, concentrically striated on the under surfaces, and the oblong quadrangular aperture. I have not met with any specimen which presents these characters; and as the original specimen, unfortunately, has been broken, I cannot give any description or figure of the species. It is not improbable that the shell described by Mr. Sowerby was a fragment, consisting of the early volutions of one of the larger species I have described, possibly of *P. rotundatus*, in which the whorls, in the young state, are somewhat adpressed and the aperture is subquadrate.

Genus 14th. **ANCYLUS**.* *Geoffroy*.

ANCYLUS, *Geoffroy*, 1767; *Müller*, 1774; *Draparnaud*, 1805; *De Roissy*, 1805; *Férussac*, 1819; *Lamarck*, 1820; *Blainville*, 1825; *Guilding*, 1821.

PATELLA (spec.), *Linnaeus*, *Bruguière*, *Montagu*.

HELICION (spec.), *Montfort*, 1810.

ANSULUS vel **ANSYLUS**, *Gray*, 1840.

Gen. Char.—Patelliform, thin, obliquely conical, sinistral; apex rather pointed, compressed, not lengthened nor spiral, turned sidewise towards the right margin and backwards, not marginal: aperture oval or oblong, margins simple.

This genus, first withdrawn by Geoffroy from the *Patellæ*, was rejected both by Linnaeus and Bruguière, but was revived by Draparnaud, and placed near the *Limnæidæ*, on account of the similarity between the animal and those of *Limnæa* and *Planorbis*. Férussac, who had noticed the occasional ascent of the animal to the surface of the

* Etym. Ἀγκύλος, crooked, twisted.

water, and assumed that this was for respiration, also placed the genus among the aquatic Pulmonata. On the other hand, Lamarck and Blainville, although they adopted the genus, retained it, provisionally, the former among the *Calyptracea*, the latter among the *Scutibranchia*. Subsequently, the Rev. Mr. Guilding, in his 'Zoology of the Caribbean Islands,'* gave the generic characters of the animal, and described the respiratory apparatus as consisting of a small branchial plume placed on the left side, near the excretory orifice; and M. Deshayes, misled by this description, has, in the 2d edition of Lamarck's 'Histoire Naturelle,' rejected the supposition of the animal being a pulmonated mollusc. The more recent observations of the Rev. G. M. Berkeley† have shown, however, that the animal, in its organs of respiration, resembles those forming the present order, and that it is, in fact, a true pulmonated mollusc. The respiratory orifice is protected by a valvular enlargement of the margin of the mantle, which, it is conjectured, was mistaken by Mr. Guilding for a branchial plume. The genus, as originally proposed, embraced as well dextral as sinistral species. The dextral species have been withdrawn by Mr. Gray, under the generic name *Velletia*, (*Acroloxus*, Beck;) a division the necessity for which has been questioned, but which, for the reasons stated under the genus *Velletia*, I have adopted, and the present genus is therefore confined to the sinistral species.

The animal is hermaphrodite, but the union of two individuals is necessary for fecundation: the head is furnished with two cylindrical or triangular retractile tentacles, oculated at their bases; the foot is short, and attached to the abdominal mass, and the mantle is large and free, with a simple continuous margin. The living species are not numerous; one only, *A. fluviatilis*, is found in this country and in central and southern Europe; the rest occur principally in central America. They live in fresh-water, preferring gentle streams.

Four fossil species have been described and referred to this genus, all from the Eocene formations, viz. *A. elegans* (Sow.), from Hordwell; *A. depressus* (Desh.), from the neighbourhood of Versailles; *A. perditus* (Desmar.), from the fresh-water limestone of Ulm; and *A. compressus* (Nyst.), from the neighbourhood of Antwerp. The first two are *Velletiæ*; the descriptions and figures of the last two are insufficient for determining to which genus they belong.

No. 63. *ANCYLUS?* *LATUS*. *F. E. Edwards*. Tab. XIV, fig. 15 *a-b*.

A. testá conoideá, depressá, latá; vertice submediano: aperturá oblongá, obovatá.

The imperfect state of the only specimen I possess, prevents my doing much more than to record the occurrence of this shell, which I refer to the present genus with hesitation. It is distorted at the posterior extremity, and presents the appearance of

* 'Zoological Journal,' vol. iii, p. 535.

† *Ibid.*, vol. v.

a sinus somewhat resembling that in the shells of the *Limacina*, but greatly exaggerated; this, most probably, is due to the accident which produced the distortion, or to some cause similar to that to which Mr. Gray attributes the sinus in Michaud's *A. sinuosus*. The shell also is thicker than is usual in this genus; but the shelly matter has been absorbed and replaced by carbonate of lime, and a slight thickening may have taken place in that process. It may be described as sub-conical, and much depressed, with the vertex about half way between the margin and the middle; the aperture is oblong and widely obovate. In the great depression of the shell this species resembles *A. (Velletia) depressus*, Desh.; but the aperture is more equally rounded at the extremities.

Size.—Length about $\frac{1}{4}$ of an inch; width, about 2-10ths.

Locality.—Sconce.

Genus 15th. VELLETTIA.* Gray.

ACROLOXUS, Beck, 1837.

VELLETTIA, Gray, 1840.

Gen. Char.—Dextral, with the apex turned sidewise towards the left margin; in all other respects resembling *Ancylus*.

The dextral forms referred to *Ancylus* were first withdrawn by Beck, under the generic name *Acroloxus*, but without any description; the genus was afterwards defined by Mr. Gray under that of *Velletia*. The animal, so far as its organisation is known, as well as the shell, resembles *Ancylus*, except that it is dextral and not sinistral; and the genus has not been received without question, inasmuch as, apparently, it depended on a character insufficient in itself for generic distinction. Mr. W. Thompson, however, in his 'Remarks on the dentition of British Pulmonifera,' to which I have before referred, states that, in their dentition, "*Ancylus* and *Velletia* present widely distinct characters, clearly showing that they do not belong to one genus. In *Ancylus* there are thirty similar lateral teeth in a straight line on each side of the central tooth, and then there is a slight curve through a series of six more teeth, where a trifling change in their form occurs. In *Velletia*, on the contrary, no part of the horizontal row is straight; its central part is much arched, and is composed of the central tooth and twelve lateral teeth on each side, which do not alter much in form. Then comes one tooth of a different form, and lastly, six more on each side, which latter are in a slight curve." A closer examination of the comparative anatomy of the two animals will probably afford additional reasons for the separation of the present genus; in the meantime, I have retained it on the ground of the different characters of the dental apparatus recorded by Mr. Thompson.

The living species are very few: one, *V. lacustris*, is found in this country; the

* A name without signification, used by Mr. Gray on the principle advocated by Fabricius.

others occur principally in the West Indies and South America. The two species before mentioned, *V. elegans* (Sow.), and *V. depressa* (Desh.), are, I believe, the only fossil species hitherto described.

No. 64. *VELLETIA ELEGANS*. *Sowerby*. Tab. XIV, fig. 2 *a—d*.

ANCYLUS ELEGANS. *Sow.* 1826. *Min. Con.*, vol. vi, p. 64, t. 533.

— — *Lyell and Murch.* 1829. *Sur les dépôts, &c. du Cantal.*

— — *Bouillet.* 1836. *Cat. des coq. foss. de l'Auvergne.*

A. testá convexá, subconicá, radiatim subtilissime striatá; vertice obliquo, excentrico, sub-marginali: aperturá longitudinali, ob-ovali.

This elegant shell, for the discovery of which we are indebted to Sir Charles Lyell, is convex and subconical, with an oblique excentric vertex, placed near the posterior extremity. The surface, under a high magnifying power, presents exceedingly fine striæ, radiating from the vertex towards the margin; the mucro is frequently eroded. The aperture is longitudinal and obovate, the wider part being the anterior extremity.

The shell, in this species, is not so oblong and compressed as in the recent *V. lacustris*, and the vertex is nearer the margin. In the French species, *V. depressa*, (Desh.) the shell is more depressed, the anterior extremity is wider, the posterior extremity is narrower, and the vertex is more nearly central.

Size.—Elevation rather more than 1-20th of an inch; length rather more than 3-20ths; greatest width 2-20ths.

Localities.—Hordwell. *French*: Veours in the Cantal.

Family—AURICULIDÆ.

Genus 16th. *MELAMPUS*. *Montfort*.

VOLUTA, (sp.,) *Linn.*

MELAMPUS, *Montf.*, 1810; *Beck*, 1837; *Gray*, 1840.

CONOVULUS, *Lam.*, 1812; *Cuvier*, 1817; *Beck*, 1837.

AURICULA, (sp.,) *Lam.*

ALEXIA, *Leach*, 1819

CONOVULA, *Féruss.*, 1819.

PEDIPES, (sec. C.,) *Blainville*, 1825.

MELAMPUS, *Lowe*, 1832.

CONOVULUM, *G. Sowerby, jun.*, 1841.

RHODOSTOMA and *MELAMPUS*, *Swain*, 1840.

Gen. Char.—Shell oval or elongate, sub-cylindrical; generally smooth, and with a short conoidal spire: aperture rather long and narrow; peritreme continuous, with two

or three folds upon the columella; outer lip sometimes simple and sharp, sometimes thickened, and occasionally denticulated within.

The genus *Auricula*, as described by Lamarck, was confined to land shells; and that of *Conovulus*, proposed by him for certain shells which he considered to be fluviatile, he afterwards suppressed under the impression that they also were land shells. The animals which have been referred to the genus *Auricula* have, however, various habitats: some are terrestrial; others live in ponds or fresh-water marshes; and others, again, are inhabitants of the sea, or are found in brackish water near the mouths of rivers, or in salt-water marshes. Some of these groups are distinguished by peculiarities in the animals or their shells; and they, accordingly have been withdrawn from *Auricula* as distinct genera. The present genus, which corresponds with Lamarck's *Conovulus*, was first separated by Montfort for a shell from the shores of Cayenne. The animal resembles that of *Limnæa*; the head is probosciform, notched in front, and furnished with two filiform contractile tentacles, slightly annulated, and oculated at their inner bases; the foot is obovate and obtuse before and behind; the mantle united to the neck, with the exception of a perforation at the junction of the outer and inner lips. The *Melampodes* are strictly marine animals, although they are frequently found in brackish waters near the mouths of rivers or salt-water marshes; they are capable of living out of water for a long period, and Mr. Lowe, in fact, characterises them as amphibious.

The living species are not numerous; three are inhabitants of our own shores; the others are found principally in warm climates. The fossil species hitherto described are from the Eocene and later formations, and have for the most part been referred to *Auricula*.

The peculiarity, observed by Montagu in *Auricula denticulata*, of the columella not extending further than the upper part of the body whorl, is stated by Mr. Gray to be common to most species in the family; and to be caused generally by the animal absorbing the septa which separate the upper whorls, and thus converting the spire into a single cavity, as it enlarges the shell at the edges of the aperture.

NO. 65. MELAMPUS TRIDENTATUS. *F. E. Edwards. Tab. X, fig. 4 a—b.*

M. testá ovato-ventricosá, crassá, lævi; spirá conico-depressá, apice obtusiusculo; anfractibus sex vel septem, sub-cylindræis, superne depressiusculis: aperturá auriformi, angustá, labro interne incrassato, antice reflexo: columellá marginatá, tridentatá.

A thick, smooth, ovate, ventricose shell, with a short conical spire and a bluntish apex; volutions six or seven, sub-cylindrical, and somewhat depressed round the suture; the aperture long, narrow, and ear-shaped; the outer lip rather enlarged and inflected in front, and thickened internally, presenting an elevated sharpish ridge, which extends from a little above the middle of the whorl to the columellar lip. The colu-

mella is furnished with three distinct folds, of which the middle one is the largest and the posterior one the smallest; the outer lip is slightly reflected, but not so as to cover the umbilicus.

This species, in its general form, much resembles *C. pyramidalis* (Sow.), but the whorls are not so convex, and the sutures are nearer to each other, so that the spire is shorter and the aperture longer and narrower. The columella also presents three folds, instead of the two which distinguish the crag species.

The shell figured is, I believe, unique; it is one of the many valuable additions made to our Eocene fauna by the "English Natural History Society," under the able direction of Mr. Charlesworth. It forms part of the collection in the Museum of the Philosophical Society of York, who have kindly allowed me the use of it for description.

Size.—Axis, 7-10ths of an inch nearly.

Locality.—High Cliff, Hampshire.

Genus 17th. PEDIPES.* *Adanson*.

PEDIPES, *Adanson*, 1757.

— *Féruss.*, 1819; *Menke*, 1828; *Desh.*, 1832; *Beck*, 1837; *Bonn*, 1838; *Gray*, 1839; *Swain.*, 1840; *G. Sow., jun.*, 1842; *Desh.*, 1843.

— (sec. B), *Blainville*, 1825.

POLYDONTA (sp.), *Fischer*.

BULIMUS (sp.), *Bruguière*.

TORNATELLA (sp.), *Lamarck*.

AURICULA (sp.), *Reeve*.

Gen. Char.—Shell small, thick, sub-globose or oval; spire pointed, not much elevated: aperture sub-ovate or linear; outer lip thin, sharp, with one or two folds within; columella with two folds; one large fold on the penultimate whorl.

This genus was proposed by Adanson on a small marine shell from the coast of Senegal; and, although it was confounded by Bruguière with *Bulimus*, and by Lamarck with *Tornatella*, it appears to have been generally adopted. The animal, which Adanson describes as very small in comparison with the shell, is furnished with two filiform tentacles, oculated at their inner bases; the muzzle is rounded and notched in front, as in *Melampus* and *Limnæa*; the foot is elliptical and divided into lobes separated by a deep transverse furrow; the anterior lobe is transverse, wider than long, and rounded in front; the posterior one longer than wide, and somewhat narrowed

* Etym. Adanson gave the name *Pietin* (quasi *pieton*, a walker,) to this genus on account of the singular way in which the animal walks, and the Latin name, *Pedipes*, imposed by him, has probably reference to this peculiarity.

behind. The mode of progression, as described by Adanson, is as follows: the animal, having attached itself by the posterior lobe, protrudes the anterior lobe as far as the hollow part of the foot, which is capable of considerable extension, will permit; and the posterior lobe is then advanced until it touches the anterior one. This movement, quickly repeated, enables the animal to advance with a rapidity apparently disproportioned to its size. Adanson states that, on the animal emerging from or withdrawing into the shell, the lobes pass one on each side of the large posterior fold, which, being continued into the interior of the shell, keeps them constantly separated.

Only three or four living species are known, all from tropical regions. Of fossil species, M. D'Orbigny, in his 'Prodrome de Paléontologie,' cites five, which he refers to this genus, from the Eocene formations in France.

NO. 66. PEDIPES GLABER. *F. E. Edwards.* Tab. X, fig. 9 a—c.

P. testá minutá, ovali, ventricosá, glabrá; anfractibus quaternis vel quinis, ad suturam adpressis; spirá mediocri: aperturá semiovali; labro uniplicato, antice intus incrassato; plicá columellari posteriori, angulatá, flexá.

A minute, oval, ventricose and smooth shell; volutions four or five, adpressed at the posterior margins so as to form a narrow band round the suture; the spire moderately elevated: the aperture semioval; the outer lip with a sharp edge, and furnished with a fold placed about the middle, and in front of which the lip is thickened internally; the large columellar fold on the penultimate whorl is angulated and bent so as to present a slight concavity on the anterior surface, and a corresponding convexity on the posterior one.

This exceedingly rare and interesting shell forms part of Mr. D'Urban's valuable collection.

Size.—Axis, 2-20ths of an inch nearly; diameter, rather more than 1-20th.

Locality.—High Cliff.

SUB-ORDER—*PHANEROPNEUMONA* (Gray), *OPERCULATA*, (Férussac.)

Family—CYCLOSTOMIDÆ.

Genus 18th. CYCLOTUS.* *Guilding.*

CYCLOTUS, *Guild.*, 1840, (fide *Swainson.*)

POTERIA, *Gray*, 1840.

APEROSTOMA, *Troschel, Pfeiffer*, 1847.

CYCLOTUS, *Gray*, 1850.

* Etym., κυκλωτος, rounded.

Gen. Char.—Spire sub-turbinate, depressed, or discoidal; apex obtuse; whorls rounded: aperture nearly circular, with a small siphon at the posterior extremity; peristome simple, sometimes reflected; widely umbilicate: operculum thick, calcareous, formed of two laminæ with a groove on the edge between them; outer surface rather concave; whorls numerous, enlarging gradually, with the outer edge reflected, forming a spiral fringe.

The genus *Cyclostoma*, as originally proposed by Lamarck, rested entirely on the circular form of the aperture, a character which applied as well to land as to marine and fresh-water species, and brought together animals essentially different, not only in their organisation, but in the structure of their shells. From this heterogeneous group, Draparnaud withdrew the marine species, and restricted the genus to the land and fresh-water species; and Lamarck afterwards formed for the marine and fresh-water species the genera *Scalaria*, *Delphinula*, *Paludina* and *Valvata*, and confined the genus to the free-air breathing land species. The animal is unisexual and operculated, with a probosciform head, furnished with two subulate annulated tentacles, oculated at their external bases; the respiratory opening, unlike that of the preceding sub-order, is largely open in front, resembling that of many of the branchiated molluscs. These characters separate the genus and its sub-genera as a distinct group among the pulmonated molluscs. The modification of the organs of respiration, to which many zoologists have attached great importance, has been considered by others as a character of comparatively small value; and the resemblance which the animal of *Cyclostoma* presents to that of *Turbo*, in many important particulars, induced Cuvier to disregard the peculiarity of the respiratory apparatus, and to place the genus in the same family as *Turbo*; and M. Deshayes* has suggested that the *Cyclostomidæ* should form a distinct group near to or among the *Turbinacea*. Such an arrangement, however, cannot consistently be adopted in any system in which the mode of respiration is admitted as an ordinal character; and consequently the *Cyclostomidæ* are retained, almost universally, among the pulmonated molluscs.

As ultimately restricted by Lamarck, the genus *Cyclostoma* comprised two groups, which presented distinct forms of the operculum; that appendage being formed, in one group, of a few rapidly enlarging whorls, and, in the other, of numerous slowly increasing whorls. Each of these groups comprised species in some of which the shells were more or less widely umbilicated, and in others imperforate, or nearly so. Montfort availed himself of the condition of the umbilicus, a character in itself of little generic value, and separated the widely umbilicated species under the generic name *Cyclophorus*, retaining the imperforate species for his genus *Cyclostomus*; but the characters presented by the opercula were altogether overlooked or disregarded. Each genus, therefore, comprised species presenting different forms of operculum;

* Lam. Hist. naturelle, 2d edit., vol. viii, p. 351.

and numerous genera and sub-genera have, in consequence, been withdrawn by Gray, Guilding, Troschel, Pfeiffer, and others, on characters taken principally from modifications of the operculum. The present genus was separated by Mr. Guilding, from *Cyclophorus*, for some shells from the West Indies; it is distinguished by the thick calcareous operculum, formed of two distinct layers. The animal, so far as it is known, resembles that of *Cyclostoma*.

The recent species are not very numerous. Mr. Gray, in his Nomenclature of Molluscous Animals, &c., in the British Museum, part "Cyclophoridae," gives a list of twenty-eight species, all of which are from the West Indian Islands, or from Central or South America.

No. 67. *CYCLOTUS CINCTUS*. *F. E. Edwards*. Tab. X, fig. 1 *a—c*.

C. testá conico-depressá, lineis tenuibus spiraliter cinctá; anfractibus quinque vel sex, rotundatis, ultimo paullo decurrenti: umbilico magno; aperturá sub-circulari.

This remarkably elegant shell is conical and somewhat depressed, formed of five or six rounded whorls, and ornamented with numerous, irregular, rather sharp, spiral, raised lines, some of which are more elevated than the rest; these lines are spread over the whole surface of the shell; but they are more crowded on the upper than on the under surface, and are very prominent in the umbilicus, where they are sometimes strongly decussated by the lines of growth. The last whorl is slightly decurrent; the aperture is nearly round, with the peristome a little reflected, but not much so; and the umbilicus is very wide, being nearly one third of the diameter of the shell.

Two or three detached opercula have been obtained by Mr. D'Urban, which present all the leading characters of the opercula of the living species; but, as yet, it cannot be determined to which of the two fossil species they belong. They are thick, testaceous, slightly concave externally, formed of five or six slowly enlarging whorls with the external fringe deeply grooved. One of them is represented by fig. 12 *a—b*, Tab. X.

This species has hitherto been found only at Sconce, where it occurs rather plentifully; but specimens with the shell preserved are rare.

Size.—Axis, 5-10ths of an inch; diameter, rather more than 6-10ths of an inch.

No. 68. *CYCLOTUS NUDUS*. *F. E. Edwards*. Tab. X, fig. 11 *a—b*.

C. testá ovato-conicá, laevi; spirá mediocri; anfractibus quinque convexis: aperturá rotundatá, umbilico parvo.

A smooth ovately-conical shell, with a moderately elevated spire, formed of five convex volutions: aperture nearly circular; umbilicus narrow but deep.

The surface of the shell in this species is perfectly devoid of ornament, a character

which at once separates it from the preceding species; the casts, in which state specimens are most commonly found, may be distinguished by the more elevated spire, the less effuse base, and the narrower umbilicus.

Size.—Axis, half an inch; diameter, nearly the same.

Locality.—Sconce, where, although it is not by any means rare, it is not so common as *C. cinctus*.

Genus 19th. CRASPEDOPOMA.* *Pfeiffer*.

CRASPEDOPOMA, *Pfeiff.*, 1847.

VALVATA (sp.), *Menke*.

BOLANIA, *Gray*, 1842.

Gen. Char.—Shell sub-turbinate; last whorl slightly produced, straight, attenuated towards the aperture, which is circular; peristome continuous, simple, slightly thickened; axis imperforate or narrowly umbilicate.

This is one of the genera, separated by Pfeiffer, (*Zeitsch. für Malak.*) depending principally on the characters presented by the operculum. That appendage in the present genus differs from the operculum of *Cyclotus*, in being horny instead of calcareous; and in having, on the outer edge of the internal disc, a circular prominence which overlaps the margin of the aperture; the external disc is also flat, and not concave, as in *Cyclotus*. The shell is distinguished by the attenuation of the last whorl, which gives a contracted appearance to the aperture, a character not found in any other group of the *Cyclostomidæ*. Only two living species are known; both are from Madeira.

No. 69. CRASPEDOPOMA ELIZABETHÆ. *F. E. Edwards*. Tab. XIV, fig. 14 a—c.

C. testá parvá, conicá, perforatá; lineis spiralibus, numerosis, tenuissimis, ornatá; apice obtusiusculo: anfractibus quinis, rotundatis, ultimo decurrenti: aperturá circulari, intus incrassatá; umbilico angusto.

A small trochiform shell, ornamented with numerous fine, spiral, raised lines, and formed of four or five rounded volutions, the last of which is attenuated towards the aperture and slightly decurrent; the spire is moderately elevated, with a somewhat blunt apex: the aperture is nearly circular, and slightly thickened internally; the umbilicus is narrow.

Without the assistance to be derived from the operculum, it is scarcely possible to determine correctly to what genus the present shell should be referred. It has much the appearance of a *Valvata*; but the thickened peristome indicates its affinity to the

* Etym., κράσπεδον, a rim or border; πωμα, a lid, (the operculum.)

Cyclostomida, and the attenuation of the last whorl induces me to place it in the present genus, apparently the only one in the family to which that character belongs. I refer it, however, to *Craspedopoma* provisionally only, until, by the acquisition of more perfect specimens, its true position may be ascertained.

This elegant shell was discovered by Mr. D'Urban and myself, on a recent visit to the Isle of Wight, accompanied by Miss D'Urban, to whom, in commemoration, I have ventured to dedicate it. It is apparently very rare, and although we procured several specimens, not one had the shell preserved.

Size.—Axis, 4-20ths of an inch; diameter, 3-20ths nearly.

Locality.—Sconce.

HELICINA.—The shell described by Lamarck as *Helicina dubia* is found in the High Cliff sands, and at Barton; it is, however, a *Rotella*, and will be described in its proper place.

In order that this account of our Eocene pulmonated molluscs may contain all the species at present known, I subjoin the description of a shell acquired by me since the early part of this monograph was printed, and which I have referred to *Bulimus*, although the aperture is of a form unusual in that genus.

No. 70. *BULIMUS HETEROSTOMUS*. *F. E. Edwards*. Tab. XIV, fig. 1 *a—d*.

B. testá parvâ, conicâ; spirâ elevatâ, acutiusculâ, apice deciduo; anfractibus septenis vel octonis, rotundatis, transversim regulariter lineatis; lineis tenuissimis, numerosis, perobliquis: aperturâ rotundo-ovatâ, peristomate reflexo.

This shell has so much of the character and appearance of *Truncatella*, that I should be inclined to refer it to that genus; but it is found associated with land and true fresh-water shells only, in a formation which does not present any trace of marine origin. The nearly circular aperture resembles that of *Cyclostoma*; the transverse lineation, however, is a character which, I believe, is not ever found in that genus. I have referred it to *Bulimus*, but with some hesitation. It is a small conical shell, with an elevated, tapering, pointed, spire, the apex of which is subject to decollation; the seven or eight whorls of which it is formed, are rounded, separated by a deep suture, and ornamented with fine transverse raised lines, which are numerous, regular, and very oblique; the aperture is roundedly ovate, apparently thickened within, and with

the margin slightly reflected. In specimens which have not attained the full size, the bases of the whorls are flattened and sharply angulated at the outer margins.

This species appears to be well characterised; it is separated by the striation and the form of the aperture, from the several small fossil species described by Lamarck and by Deshayes.

Size.—Axis 3-10ths of an inch; diameter not quite 3-20ths.

Localities.—Sconce and Headon Hill; apparently, it is very rare.

I cannot close the present Monograph without noticing certain oviform substances which occur, rather plentifully, in the fresh-water formation at Sconce, as to the nature and origin of which various opinions have been entertained. I have been fortunate enough, however, to obtain lately, specimens which appear to me to remove all doubt on the subject, and to show conclusively that these substances are, in fact, the remains of the eggs of some animal. The condition in which they most usually occur, is that of casts formed of the same material as the rock in which they are imbedded; they present great regularity of form, and resemble, in every respect, the internal cast of an egg. Occasionally only a hollow space, the impression of the egg, is found without the internal cast, and without the calcareous covering, which has been wholly absorbed; and sometimes, though more rarely, the covering of the egg itself occurs; but in that case the calcareous matter has always been replaced by carbonate of lime, and in this state the inside is sometimes empty—sometimes it is filled with the matrix. The absorption of the calcareous matter, and its occasional replacement by carbonate of lime, are the conditions in which, as we have already seen, the testaceous remains of Mollusca imbedded in the same formation are frequently found. The hypothesis that these substances are the casts or remains of eggs, appears to me to be the only one by which the different states in which they are found can be satisfactorily explained. Where the egg has been broken, the cavity of the shell has been filled by the fluid matrix, and the internal cast is formed. The eggs may, in some instances, have been broken accidentally; but they appear almost universally to have been broken by the young animal on effecting its escape; for one end of the casts is free, smooth, and regular in form; while the other end, apparently broken by the animal, is irregular and connected with the external matrix. If, on the other hand, the egg has been imbedded unbroken, only the cavity formed by it in the matrix remains; or if the covering of the egg is found, it is either quite empty, or small globules of the carbonate of lime, by which the shell has been replaced, are found attached to the sides. I assume therefore that the substances in question are the remains of eggs, but of what animals it is more difficult to determine. They are of different sizes, varying in length from 2-10ths of an inch to nearly two inches; in shape they are oval, rounded equally at both

TAB X.

Fig.

1. *Cyclotus cinctus*. No. 67, *p.* 117.
 - a.* Back view of specimen with the shell preserved.
 - b.* Front view of a cast.
 - c.* Back view of ditto.

2. *Helix globosa*. No. 16, *p.* 63.
 - a.* Front view of a cast of a shell in an intermediate stage of growth.
 - b.* Front view of a cast of a young shell.
 - c.* Back view of an adult specimen with the shell partly preserved.
 - d.* Front view of ditto.

3. *Helix tropifera*. No. 18, *p.* 64.
 - a.* Front view of a cast.
 - b.* Upper surface of ditto.
 - c.* Under surface of ditto.

4. *Melampus tridentatus*. No. 65, *p.* 113.
 - a.* Front view.
 - b.* Back view

5. *Helix D'Urbani*. No. 15, *p.* 62.
 - a.* Front view, nat. size.
 - b.* Ditto, magnified.
 - c.* Under surface, magnified.
 - d.* Upper surface „

6. *Helix omphalus*. No. 19, *p.* 65.
 - a.* Front view, natural size.
 - b.* Ditto, magnified.
 - c.* Upper surface, ditto.
 - d.* Under surface, ditto.
 - e.* Portion of a whorl, magnified.

Fig.

7. *Helix labyrinthica*. No. 20, *p.* 67.
 - a.* Back view, natural size.
 - b.* Under surface, magnified.
 - c.* Back view, ditto.
 - d.* Front view, ditto.
 - e.* Portion of the whorl magnified.

8. *Helix Vectiensis*. No. 14, *p.* 62.
 - a.* Back view, natural size.
 - b.* Under surface of a cast, magnified.
 - c.* Front view, magnified.
 - d.* Back view of a cast, ditto.
 - e.* Portion of the whorl, magnified.

9. *Pedipes glaber*. No. 66, *p.* 115.
 - a.* Back view, nat. size.
 - b.* Ditto, magnified
 - c.* Front view, ditto.

10. *Helix occlusa*. No. 17, *p.* 64.
 - a.* Front view of a specimen with the shell preserved.
 - b.* Back view of ditto.
 - c.* Front view of a cast.
 - d.* Under surface of ditto.
 - e.* Back view of ditto.

11. *Cyclotus nudus*. No. 68, *p.* 117.
 - a.* Front view.
 - b.* Back view.

12. Operculum of *Cyclotus*.
 - a.* View of the outer disc.
 - b.* Side view.



TAB. XI.

Fig.

1. *Bulimus politus*. No. 24, *p.* 73.
 - a.* Front view, natural size.
 - b.* Ditto, magnified.
 - c.* Back view, natural size.
 - d.* Ditto, magnified.
2. *Bulimus ellipticus*. No. 23, *p.* 72.
 - a.* Front view
 - b.* Side view.
 - c.* Fragment of a large specimen in the Brit. Mus.
 - d.* Side view of a cast.
 - e.* Side view of a cast, young.
 - f.* Fragment from Primrose Hill. (*B. tenuistriatus*, G. Sow.)
3. *Succinea imperspicua*. No. 29, *p.* 81.
 - a.* Front view, natural size.
 - b.* Ditto, magnified.
 - c.* Back view, natural size.
 - d.* Ditto, magnified.
4. *Helix sub-labyrinthica*. No. 21, *p.* 69.
 - a.* Front view of a cast, natural size.
 - b.* Impression of the whorl, magnified.
 - c.* Back view, magnified.
5. *Helix Headonensis*. No. 22, *p.* 70.
 - a.* Upper surface of a cast. Natural size.
 - b.* Ditto, ditto, magnified.
 - c.* Portion of the whorl of ditto, magnified.
 - d.* Front view of ditto, magnified.
6. *Clausilia striatula*. No. 28, *p.* 79.
 - a.* Front view of a cast of a young shell, nat. size.
 - b.* Ditto ditto, magnified.
 - c.* Front view of cast with parts of the shell preserved, nat. size.
 - d.* Ditto, ditto, magnified.

e and *g.* Views of casts of adult shells, showing the aperture, nat. size.
f and *h.* Ditto ditto, magnified.
7. *Pupa perdendata*. No. 26, *p.* 77.
 - a.* Back view of a cast (shell partly preserved), natural size.
 - b.* Ditto ditto, magnified.
 - c.* Front view of ditto, natural size.
 - d.* Ditto ditto, magnified.
 - e.* Impression of the whorls in the matrix, magnified.



TAB. XII.

Fig.

1. *Achatina costellata*. No. 25, *p.* 75.

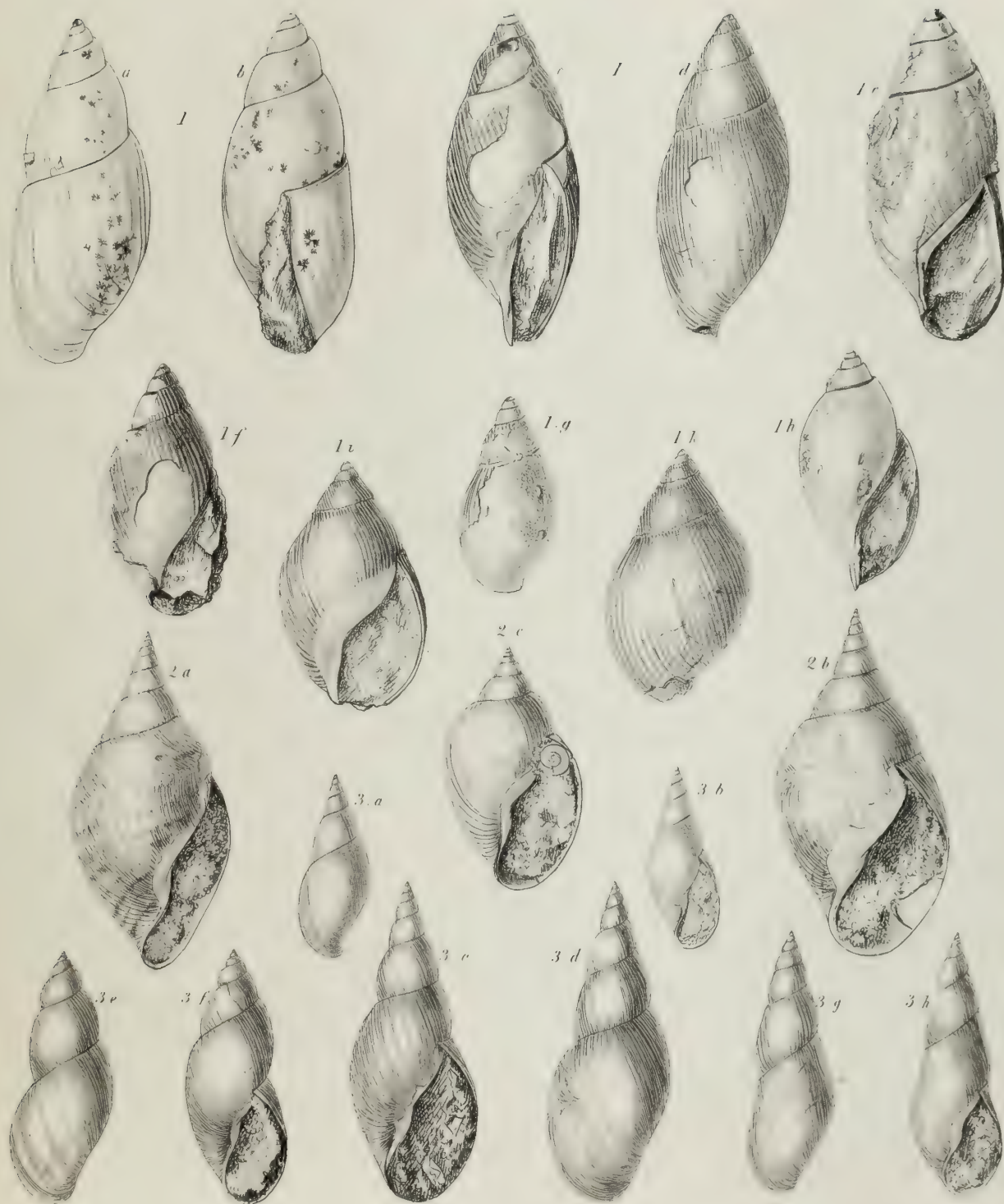
- a.* Back view of a cast.
- b.* Side view of ditto.
- c.* Front view of a specimen with the shell partly preserved.
- d.* Back view of ditto.
- e.* Front view of a cast.
- f.* Ditto of ditto, shell partly preserved. Young shell.
- g.* Back view of a cast of a young shell.
- h.* Front view of ditto.
- i.* Back view, var. *abbreviata*.
- k.* Front view, ditto.

2. *Limnæa caudata*. No. 30, *p.* 83.

- a.* Side view.
- b.* Front view.
- c.* Ditto, var. *abbreviata*.

3. *Limnæa longiscata*. No. 32, *p.* 85.

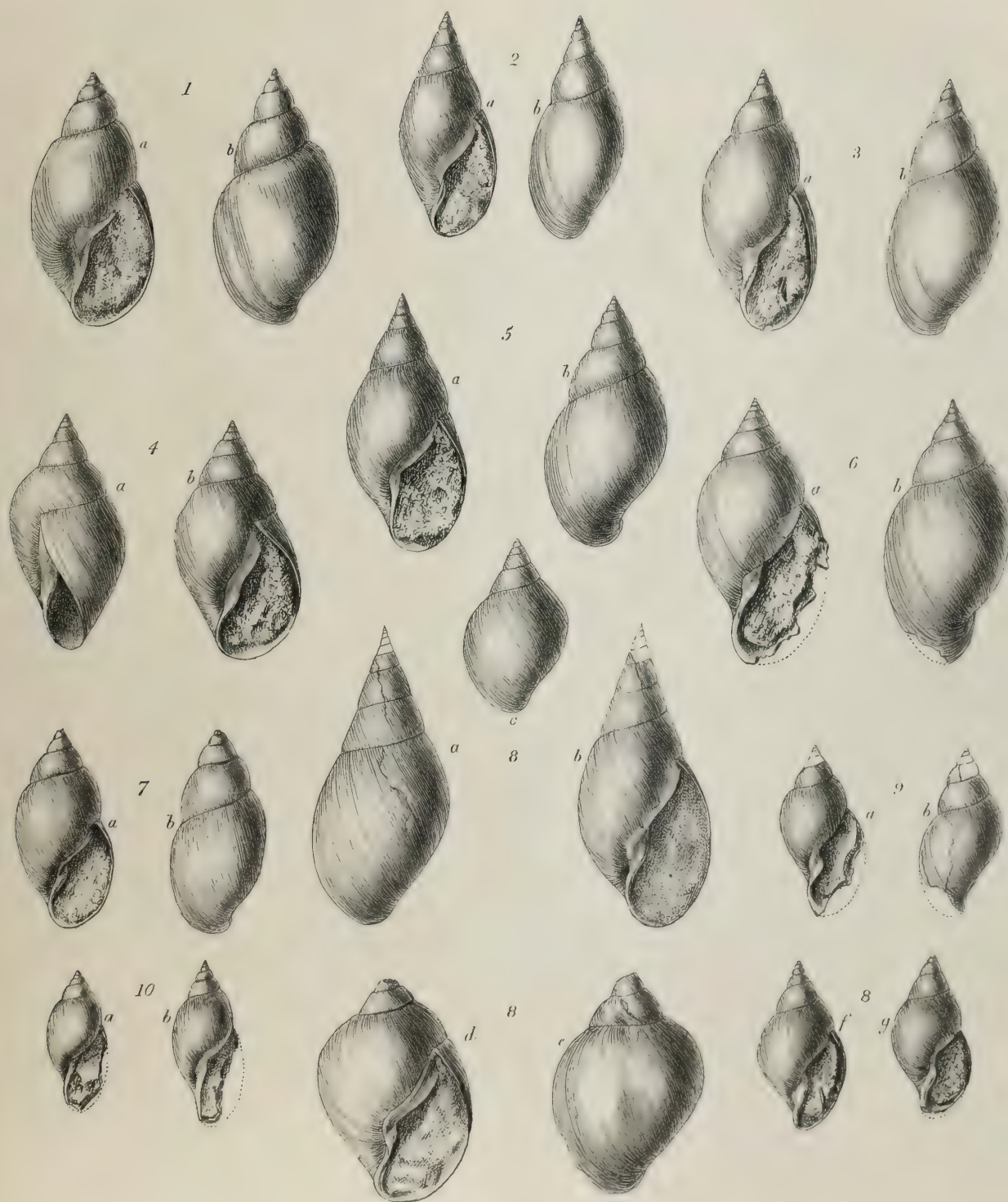
- a.* Back view, intermediate state of growth.
- b.* Front view, ditto.
- c.* Front view, adult shell.
- d.* Back view, ditto.
- e* and *g.* Back views, var. *distorta*.
- f* and *h.* Front views, ditto.



TAB. XIII.

Fig.

1. *Limnæa subquadrata*. No. 41, *p.* 92.
 - a.* Front view.
 - b.* Back view.
- 2 and 3. *Limnæa pyramidalis*. No. 31, *p.* 84.
 - a, a.* Front views.
 - b, b.* Back views.
4. *Limnæa sublata*. No. 35, *p.* 88.
 - a.* Side view.
 - b.* Front view.
5. *Limnæa mixta*. No. 36, *p.* 88.
 - a.* Front view.
 - b.* Back view.
6. *Limnæa tumida*. No. 39, *p.* 91.
 - a.* Front view.
 - b.* Back view.
7. *Limnæa convexa*. No. 42, *p.* 92.
 - a.* Front view.
 - b.* Back view.
8. *Limnæa fusiformis*. No. 38, *p.* 90.
 - a.* Back view of specimen from Headon Hill.
 - b.* Front view, ditto.
 - c.* Back view of ditto. Var. *deformis*, intermediate size.
 - d.* Front view of ditto ditto adult shell.
 - e.* Back view of ditto ditto ditto
 - f, g.* Front views of shells from Sconce. Intermediate stage of growth.
9. *Limnæa columellaris*. No. 40, *p.* 91.
 - a.* Front view.
 - b.* Back view.
10. *Limnæa costellata*. No. 43, *p.* 93.
 - a* and *b.* Front views.



TAB. XIV.

Fig.

1. *Bulimus heterostomus*. No. 70, *p.* 119.

a. Front view of a cast, nat. size.
b. Ditto, magnified.
c. Side view of ditto of the aperture, magnified.
d. Impression of the whorls in the matrix, magnified.

2. *Velletia elegans*. No. 64, *p.* 112.

a. View from above, nat. size.
b. Ditto, magnified.
c. Side view, ditto.
d. View of the aperture, ditto.

3. *Pupa oryza*. No. 27, *p.* 78.

a. Side view, nat. size.
b. Ditto, magnified.

4. *Limnæa sulcata*. No. 33, *p.* 87.

a. Front view.
b. Back view.

5. *Limnæa cincta*. No. 45, *p.* 94.

a. Front view.
b. Back view.

6. *Limnæa angusta*. No. 46, *p.* 95.

a. Front view.
b. Back view.

7. *Limnæa recta*, No. 49, *p.* 96.

a. Front view.
b. Back view.

8. *Limnæa gibbosula*. No. 34, *p.* 87.

a and *b.* Front views.
c. Back view.

Fig.

9. *Limnæa minima*. No. 48, *p.* 96.

- a.* Back view, nat. size.
- b.* Front view, magnified.
- c.* Back view, ditto.

10. *Limnæa fabulum*. No. 44, *p.* 93.

- a.* Front view.
- b.* Back view.

11. *Limnæa tenuis*. No. 50, *p.* 97.

- a.* Front view.
- b.* Back view.

12. *Limnæa ovum*? No. 37, *p.* 89.

- a.* Front view.
- b.* Back view.

13. *Limnæa arenularia*. No. 47, *p.* 95.

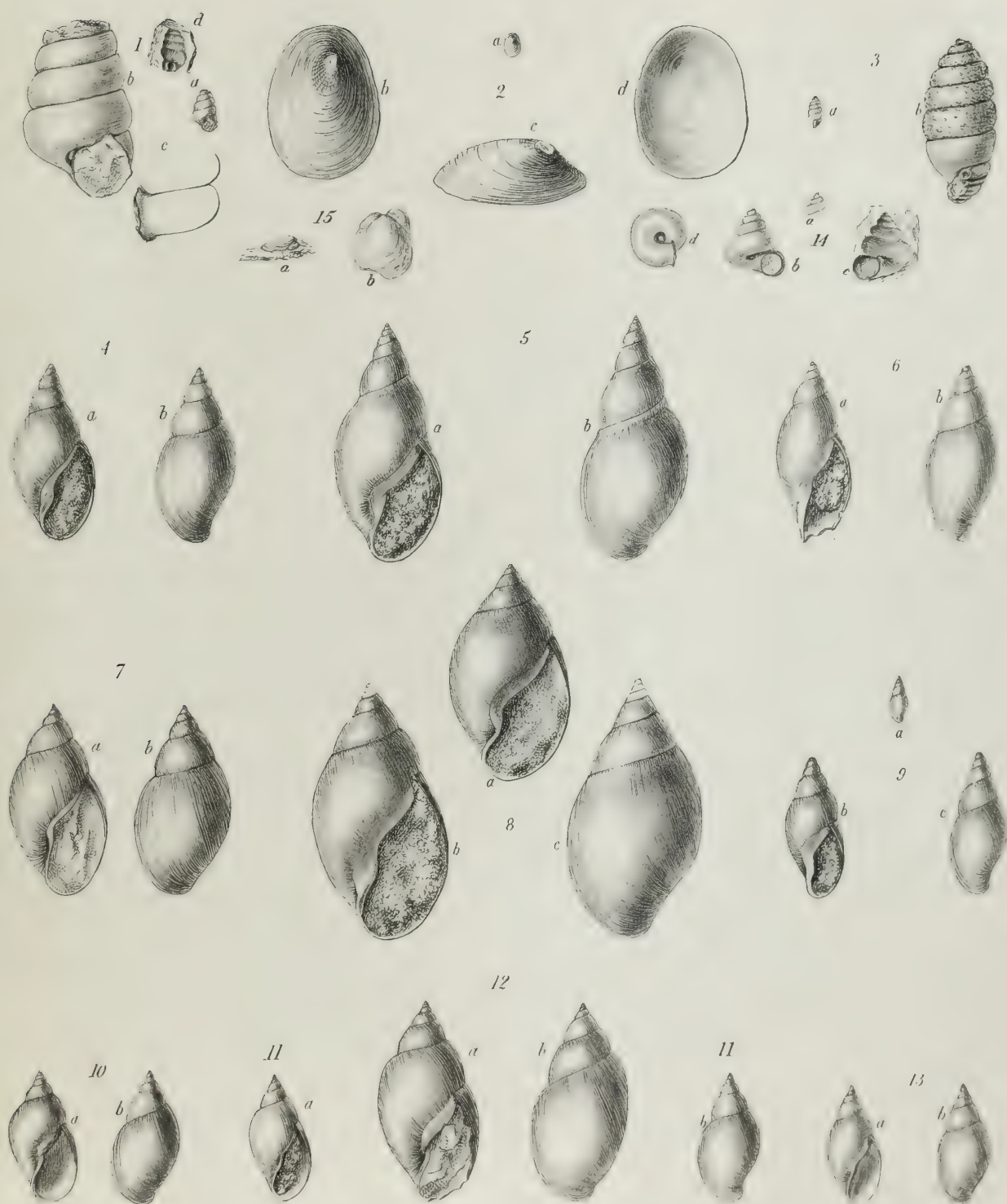
- a.* Front view.
- b.* Back view.

14. *Craspedopoma Elizabethæ*. No. 69, *p.* 118.

- a.* Front view, nat size.
- b.* Ditto, magnified.
- c.* Impression in the matrix, magnified.
- d.* View of the base ditto.

15. *Ancylus*? *latus*. No. 63, *p.* 110.

- a.* Side view, nat. size.
- b.* View from above, magnified.



TAB. XV.

Fig.

1. *Planorbis obtusus*. No. 53, *p.* 102.
 - a.* View of the upper disc (distorted specimen).
 - b.* Side view.
 - c.* Ditto (distorted specimen).
 - d.* View of the under disc.
 - e.* View of the upper disc.
2. *Planorbis platystoma*. No. 56, *p.* 103.
 - a.* View of the upper disc, nat. size.
 - b.* View of the under disc, magnified.
 - c.* View of the upper disc ditto.
 - d.* View of the aperture ditto.
3. *Planorbis oligyratus*. No. 55, *p.* 103.
 - a, b.* Views of the aperture.
 - c.* View of the under disc.
 - d.* View of the upper disc.
 - e.* View of the under disc of a cast.
4. *Planorbis rotundatus*. No. 52, *p.* 100.
 - a.* Side view showing the aperture.
 - b.* View of the under disc.
 - c.* View of the upper disc.
5. *Planorbis euomphalus*. No. 51, *p.* 99.
 - a.* View of the upper disc. Young shell.
 - b.* Ditto ditto ditto.
 - c.* Side view, showing the aperture in ditto.
 - d.* View of the under disc of ditto.
6. *Planorbis euomphalus*. No. 51, *p.* 99.
 - a.* Side view of adult shell.
 - b.* View of the under disc of ditto.
 - c.* View of the upper disc of ditto.
7. *Planorbis discus*. No. 54, *p.* 102.
 - a.* View of the upper disc, with the shell preserved (intermediate stage of growth).
 - b.* View of the under disc of a cast.
 - c.* Side view of a cast.
 - d.* View of the upper disc of a cast.

8. *Planorbis lens*. No. 57, *p.* 104.
- a.* View of the upper disc, nat. size.
 - b.* Side view, magnified.
 - c.* View of the under disc, ditto.
 - d.* View of the upper disc, ditto.
9. *Planorbis Sowerbyi*. No. 62, *p.* 108.
- a.* View of the upper disc of a cast, nat. size.
 - b.* Ditto ditto magnified.
 - c.* Side view of ditto, showing the aperture, ditto.
 - d.* View of the under disc of ditto, magnified.
10. *Planorbis tropis*. No. 58, *p.* 106.
- a.* View of the under disc, nat. size.
 - b.* Ditto ditto magnified.
 - c.* Side view of ditto ditto.
 - d.* View of the upper disc ditto.
11. *Planorbis hemistoma*. No. 59, *p.* 106.
- a.* View of the under disc, nat. size.
 - b.* Ditto ditto magnified.
 - c.* Side view of ditto ditto.
 - d.* View of the upper disc ditto.
12. *Planorbis elegans*. No. 60, *p.* 107.
- a.* View of the under disc, nat. size.
 - b.* Ditto ditto magnified.
 - c.* Side view of ditto ditto.
 - d.* View of the upper disc ditto.
13. *Planorbis biangulatus*. No. 61, *p.* 108.
- a.* View of the upper disc, nat. size.
 - b.* Side view of ditto magnified.
 - c.* View of the under disc ditto.
 - d.* View of the upper disc ditto.



THE

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MONOGRAPH

OF THE

ECHINODERMATA

OF THE

BRITISH TERTIARIES.

BY

PROFESSOR EDWARD FORBES, F.R.S., &c.

LONDON:

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1852.

ECHINODERMATA

OF THE

BRITISH TERTIARIES.

INTRODUCTORY REMARKS.

THE remains of Sea-urchins and Starfishes found in the secondary strata of the British Islands, have been sought for with avidity, and made the subjects of numerous memoirs and beautiful illustrations, whilst those that occur in tertiary beds have been treated with undeserved neglect, and are but imperfectly known. The majority of them are undescribed, even unnamed. That they are neither few nor deficient in interest, I shall show in the following Monograph. Unfortunately, a great number of them are known only from fragments. The imperfection of their relics has caused them to be slighted by collectors. Only those gentlemen who have understood their geological importance, have taken the trouble to preserve them. It is to be hoped, however, that since attention will now be called to the interest attached to these fossils, a more diligent search will be made, and both new forms and better specimens of those here recorded, be brought to light. In the present state of the subject, the descriptions of most of the species are necessarily imperfect, and the materials accumulated are not sufficient to warrant, except in a few instances, the construction of a formal diagnosis. I have therefore confined myself to a description as detailed as the specimens at my disposal have admitted.

The marine tertiaries of the British Islands can be distinctly divided into two groups, each presenting a general zoological type and *facies*. These are the *Eocene*, and those which succeed it. Under the first are included the Thanet beds and Plastic clays, the London clay and Bognor beds, the Bracklesham beds, the Barton series, and the

superincumbent fluvio-marine strata of Hampshire. Under the second, fall the Red and Coralline Crag, and the series of stratified, unstratified, and drifted deposits of marine origin, constituting the several subdivisions of the Pleistocene or Glacial formation. I regard the Crag, taken together, as stages of older Pleiocene, and the Glacial beds as newer Pleiocene. There is, within our area, a great gap between the Eocene group and the later tertiaries, indicated by the difference of their organic contents. Between the existing fauna of our seas and the oldest stage of the later tertiaries, there is a distinct and extensive relationship of identity of species. Between the later and older tertiaries, there is little or no connection indicated by organic remains.

The list of Echinoderms in our older or Eocene tertiaries is by no means small, and is sure to be increased hereafter. This is evident when we call to mind the fact, that our knowledge of the presence of two most distinct genera is confined to an acquaintance with a few spines of a single species in each, no fragment of the test having as yet been obtained, whilst of others we have found fragments only of the test, and no traces of the spines. Several of our Eocene Starfishes and Crinoids had been previously described, but of our sea-urchins not one had received a name, and only two been slightly noticed. Yet there are nine species, belonging to no fewer than seven genera. Out of all these species only one appears to have been described before, viz. the *Spatangus Omalii* of Galeotti. Out of the seven genera, no fewer than four are types which are not represented in strata of later age than Eocene. These are *Cælopleurus*, *Echinopsis*, *Eupatagus*, and *Hemiaster*. As yet no examples of *Echinolampas*, *Echinocyamus*, *Scutellina*, and *Lenita*, all genera represented not uncommonly in the Eocene strata of France and Belgium, have been found in our British beds. Of the second and third of these genera, the species of which are small and unattractive, I fully expect British examples will yet be discovered.

Of the later Tertiary Echinoderms here described, the majority is derived from the Coralline, or Older Crag. Much interest attaches to them, since we obtain through them a clear indication of some geographical relations of our area during that ancient period. These were distinctly *southern* and *eastern*. This is especially manifested in the presence of *Brissus Scillae*, still surviving in the Mediterranean, and the relations of the curious and beautiful genus *Temnechinus*, which, though peculiar to the Crag, and at present known only as a group of British Fossils, is closely connected with *Temnopleurus*, *Salmacis*, and *Mespilia*, characteristic genera of the Indo-Pacific region. This relation is also indicated by the Coralline Crag *Crinoidea*. The affinity of this division of the Crag fauna to the Mediterranean fauna is rather with a portion of the latter, of greater antiquity than the majority of its members, than with the Mediterranean assemblage, as it is at present constituted.

Among the few Echinoderms procured from the Red or Newer Crag, a distinct relationship is maintained with those of the older group, whilst on the other hand, there is manifested a more definite connection with the fauna of the British Seas, as at present constituted.

I have not had occasion to describe any Echinoderm from our Pleistocene Strata. I think, however, it is very probable, that we shall find *Echinus neglectus* in these beds in Britain, even as it has been found elsewhere in beds of corresponding age and origin. Of all the species of its genus, it is the one which ranges most nearly to the North Pole, and is a truly Arctic and Boreal type.

I have to return many thanks to the naturalists who have kindly and readily contributed the materials for this Monograph. For that portion which concerns the Crag, I have especially to thank Mr. Searles Wood, Captain Alexander, Mr. Charlesworth, Miss Alexander, Miss Ransom, Mr. Brown of Stanway, Mr. Bunbury, Mr. Morris, and Mr. Bowerbank.

For that portion which relates to the London Clay, many thanks are due, especially to Mr. Frederick Edwards, Mr. Bowerbank, Mr. Wetherell, Mr. Charles Stokes, and Mr. D'Urban.

Of the greater number of species recorded in this memoir, examples are displayed in the Collections of the Museum of Practical Geology, thanks to the public spirit and liberality of many of the gentlemen whose names I have just recorded. Mr. Edwards has most generously presented the originals of all the species described from his Collection.

EDWARD FORBES.

ECHINODERMS OF THE CRAG.

SUB-KINGDOM. — RADIATA.

CLASS.—ECHINODERMATA.

THERE are Eight Orders of Echinoderms, which, arranged in descending sequence, will stand thus:—

1. SIPUNCULIDEA.	|	5. OPHIURIDEA.
2. HOLUTHURIDEA.	|	6. BLASTOIDEA.
3. ECHINIDEA.	|	7. CYSTIDEA.
4. ASTERIDEA.	|	8. CRINOIDEA.

Of the *Sipunculidea* and *Holothuridea* no species are found in the fossil state, nor, considering the organisation of the creatures composing them, are any likely to be so preserved. The *Blastoidea* and *Cystidea* are exclusively fossil orders, and confined to Palæozoic strata. The *Crinoidea* are for the most part fossil, and chiefly Palæozoic and Mesozoic. The *Echinidea*, *Asteridea*, and *Ophiuridea* are, on the other hand, chiefly Recent, Tertiary, and Mesozoic, and but poorly represented in the earlier strata.

The Echinoderms, of which fossil remains occur in the Crag, are either *Echinidea*, *Asteridea*, or *Crinoidea*: chiefly members of the first order. It is quite possible that, many species of star fishes and of brittle stars (*Ophiuridea*) lived in company with them, although, owing to their excessive fragility, no remains are preserved to us.

ORDER.—ECHINIDEA.

The Echinoderms of this order are distinguished by their regular plated test, investing the entire body with a coat of mail. They have always two digestive orifices. Their ambulacra are always embodied in the test, and divide it into segments. Their genital orifices are placed in the centre of peculiar plates, which form an apical disk, usually in

conjunction with the plates bearing the eyes. These latter are always at the superior termination of the ambulacra. They move by suckers, which are extended from the ambulacral pores, and assist themselves in their movements by spines, which are articulated to tubercles projecting from the surface of the plates of the test.

Family.—ECHINIDÆ.

Three of the families of the Sea-Urchins are distinguished from all others, in having their anal orifice placed in the centre of the genital plates, and directly opposite to the mouth, which occupies the centre of the ventral surface. Of these groups, the *Palæchinidæ* are peculiar to Palæozoic strata; the *Cidaritidæ* and *Echinidæ* range from the commencement of the Mesozoic epoch to the present day. No *Cidaris* has, as yet, occurred in the British Crag. In the collection of Sir Charles Lyell are the spines of a very distinct species from the Black Crag of Antwerp. The *Echinidæ* are distinguished by their developed ambulacral areas, always bearing some or many primary spines, and by their rows of pores ranged in more or less distinct ranks.

Genus—ECHINUS, *Linnæus*.

Body more or less spherical; ambulacral and interambulacral segments developed, bearing on their plates, which have entire margins, tubercles of various sizes; vent central, not furnished with regular calcareous valves, but surrounded by a membrane covered more or less with irregular ossicles. Genital disk surrounding the anal space, and composed of five genital and five ocular plates, all perforated and alternating; one of the former combined with a madreporiform tubercle; ambulacral avenues composed of pairs of pores, ranged in series of three or more, always distinctly ranked near the mouth; spines of one order.

All the species of *Crag Echini* belong to the typical section of the genus, that in which the pores are ranged in ranks of three pair in each. Such forms are, at present, pre-eminently of Atlantic types. It is remarkable, that none of the common British species of this genus can be identified with those found in the Crag.

1. ECHINUS LAMARCKII. Plate I, fig. 4.

Very reluctantly, I feel obliged to designate, by a new name, the commonest of sea-urchins found in the Coralline Crag. It is very closely allied to *Echinus sphaera*, the most abundant species in the Celtic province of the Atlantic; so nearly, indeed, that not until after considerable hesitation, did I feel constrained to regard it as distinct. It differs

essentially, in a minute character, which is constant in all the numerous examples submitted to my examination; viz., in the presence of a minute granule separating the pores of each pair. Otherwise, it differs in presenting more prominent bosses upon which the spiniferous tubercles are placed, and in the more irregular dimensions of these organs. The base has constantly a tendency to concavity, not seen in *Echinus sphaera*. At the same time, I believe it to be a variety of another and rarer British species; one communicated to me from the Coast of Cornwall by my friend Mr. Peach, and described at the British Association at Edinburgh, in 1850, as a form of *Echinus melo* of Lamarck. It would appear, however, that under the name of *E. melo*, Lamarck confounded two very distinct species, and that the true *E. melo* is that enumerated under the same name by Agassiz and Desor, a Mediterranean species, which (after an examination of the original examples in the collection of the Jardin des Plantes,) does not seem to me to differ essentially from the *Echinus Flemingii* of the British and Norwegian Seas. It results that a new name must be given to the species before us, whether it be considered strictly identical with the Cornish (and Mediterranean also) sea-urchin alluded to before, or be regarded as an extinct form, as yet peculiar to the epoch of the Coralline Crag.

Body varying in convexity, a slightly depressed spheroid swelling out below; in some specimens obscurely pentangular, divided into five broad (or interambulacral) and five narrow or ambulacral segments, separated from each other by avenues of pores, which are arranged in oblique rows of three pair in each row. Towards the middle of the sides, the breadth of an interambulacral segment, as compared with an ambulacral, is as 5 to 2. All the plates are thickly covered by tubercles, of which the primaries are slightly unequal in size. The tubercles are round, imperforate, and placed on the summits of broad, gradually swelling bosses. The interambulacral plates are very broad in proportion to their height. The broadest of them bear about nine primary tubercles, which are arranged in one single and one half row, the latter towards the truncated or ambulacral end of each plate. There are about two large primaries on each ambulacral plate, the smaller ones innermost. Towards the superior extremities of the ambulacral avenues one row only becomes prominent. Among the primary tubercles are a few secondaries and many miliary granules. Between the two pores of a pair, there is usually a miliary granule. The oral aperture is one third broader than the apical disk, and occupies about one third of the breadth of the entire test. It is placed in a slight concavity, and its margin is gently indented by notches, with reflexed margins at the interambulacral sides of the avenues. The apical disk is not preserved in any of the specimens which I have examined. Internally, the pores of the avenue appear widely disjoined, and those next the ambulacral segments are larger than the opposite ones.

The spines are stout, but not very short. They are finely grooved, with numerous narrow sulci, the interspaces being smooth, and slightly convex.

A good example measured two inches and two tenths in height by three inches in breadth.

Fine specimens from the Coralline Crag of Sutton, &c., have been communicated by Capt. Alexander, Mr. Brown of Stanway, Mr. Searles Wood, and Mr. Bowerbank. This species is preserved in most collections; and specimens presented by the three first-named gentlemen are exhibited in the collections of the Museum of Practical Geology.

2. ECHINUS MELO? Plate III, fig. 10.

ECHINUS MELO, *Lamarck*. Anim. sans Vert., vol. iii, p. 45.

— — *Agassiz*. Monog. Echin. Anat. Echinus, p. iii.

— — *Agassiz and Desor*. Ann. Sc. Nat., 3d series, tom. vi, p. 365?

Mr. Searles Wood has communicated the remains of a remarkable urchin of considerable dimensions, which appears to be distinct from any I have seen from the Coralline Crag, whence it is derived. The fragment exhibits a considerable number of the plates of the dorsal surface, with well-preserved portions of two of the avenues. The plates bear few and scattered tubercles, mingled with few and scattered granules. One of the tubercles is slightly larger than the rest, on each plate. The pores are ranked in triple series, ranged at a slight angle of obliquity, and each rank set further apart from its neighbour than is usual. These arrangements approach so nearly to those I have seen in some examples of the true *Echinus melo*, that until more perfect specimens of the fossil are met with, I place it provisionally under that species.

3. ECHINUS LYELLII. Plate I, fig. 5.

Body a convex, and rather elevated spheroid. Interambulacral areas (centrally) to ambulacra, as 5 to 2. Ambulacral plates, each with a single primary tubercle, and, towards the base, a small secondary one, so that the ambulacral segments are distinguished by the presence of two very regular, rather distant rows of nearly equal close-set tubercles. From the outer or avenue-side of their bosses proceed three radiating ridges to separate the pairs of pores in the avenues. The interambulacral plates are rather high (for the genus) in proportion to their breadth. Each bears from one to three primary tubercles, of which the centre one is largest, (but all are rather small,) and a few scattered miliary granules. The tubercles appear few, in proportion to the extent of the interambulacral spaces, and the larger ones fall into rows, but not so conspicuously marked as the ambulacral rows. The pores are arranged in oblique series of three pairs in each, each pair separated from the others by the radiating ridges already mentioned. The apical disk appears to have been small in proportion to the size of the body. The mouth and under surface has been destroyed. The spines are unknown.

The only specimen (an imperfect one,) of this very distinct urchin which I have seen, measures $\frac{1.0}{1.2}$ ths of an inch in height. Although a fragment, it is in good preservation. It was discovered, by Mr. Wood, in the lowest part of the Coralline Crag, at Ramsholt.

4. ECHINUS HENSLOVII. Plate I, fig. 7.

Body a sub-depressed spheroid. Ambulacral areas to interambulacral, as 1—2. Plates of both areas thickly covered by small depressed granules and tubercles, disposed in an obscurely radiating arrangement around a somewhat larger central tubercle. The smaller tubercles densely crowded along the sutural lines. Pairs of pores disposed in oblique rows of three pair becoming less oblique, and almost falling into line near the apical disk. Apical disk rather large in proportion to breadth: its plates, in the only specimen I have seen, are wanting. The under side of this example is entirely concealed. Breadth, $\frac{7}{12}$ ths of an inch; height, $\frac{4}{12}$ ths of an inch.

A single specimen, in the cabinet of Mr. Searles Wood. It is from the Red Crag of Walton.

It is very nearly related to the *Echinus Martinsii*, an unpublished species, from Iceland, preserved in the Museum of the Jardin des Plantes.

5. ECHINUS CHARLESWORTHII. Plate I, fig. 6.

ARBACIA, species of, *Searles Wood*, MS. in *Morris*, Cat. Brit. Foss., p. 48.

Body nearly globose, with slightly tumid segments and impressed avenues; the former, thickly studded by minute crowded, nearly equal tubercles. The pairs of pores are arranged in moderately oblique rows of three in a series. Between each pore of a pair the ridge is slightly elevated, and here and there, upon the avenues, are minute granules. The ambulacral plates bear each from three to five minute, globular, primary tubercles, elevated upon narrow bosses, and differing but slightly in their dimensions. Between them are thickly scattered granules. The interambulacral plates are very broad in proportion to their height, and bear from nine to twelve primary tubercles, of which three or four on the avenue-side of each plate are slightly larger than the others, and ranged more regularly in a slightly oblique row, giving a somewhat undulated aspect to the sides. The apical disk, which is destroyed, appears to have been small in proportion to a rather large mouth. The finest specimen measures $\frac{1}{12}$ th of an inch in diameter by $\frac{1}{12}$ th of an inch in height.

I know no existing sea-urchin which can be compared with this pretty species. It is from the Coralline Crag of Ramsholt.

Genus—TEMNECHINUS, *Forbes*.

Body more or less spherical; ambulacral and interambulacral segments developed, bearing on their plate, whose sutural margins are mostly excavated, tubercles of various sizes; vent central. Genital disk surrounding the anal space composed of five

(prominent) genital and five ocular plates all perforated, and alternating; one of the former combined with a madreporiform tubercle; ambulacral avenues composed of pairs of pores indistinctly ranked; their ranks confluent throughout. Spines of one order.

The urchins for which I have constituted this genus differ from *Temnopleurus*, to which the best known species has been referred, in having the bosses of the tubercles plain, and not crenulated; in having no pores at the angles of the plates, and confluent instead of ranked series of sucker-pores throughout the length of their avenues. The last two characters also distinguish them from *Microcyphus*, as well as (with the first character) from *Salmacis*. They fill up the interval, in fact, between *Echinus* proper and the group of allied genera, with pores, as well as excavations at the angles of their plates.

It is remarkable that, as yet, no existing sea-urchin can be referred to this genus; nor are any species recorded from extra-British localities.

All the known sea-urchins having notched plates are inhabitants of tropical seas, and appear to belong almost exclusively to the Indo-Pacific province. The fossil species of the genera mentioned above are all Tertiary. They belong to *Salmacis* and *Temnopleurus*. Two species of the former genus are recorded as European fossils, one from the Nummulitic limestone, and one from the pliocene of Palermo.

The *Temnechini* are remarkable for their beauty, as well as for their rarity.

1. TEMNECHINUS EXCAVATUS. Plate I, fig. 1.

TEMNOPLÉURUS EXCAVATUS, S. V. Wood, MS. in Morris, Cat. Brit. Foss., p. 60.

— WOODII, Agassiz. Cat. Rais. des Echin., in Ann. Sc. Nat., 3d series, tom. vi, p. 360.

TEMNECHINUS EXCAVATUS, Forbes. Fig. and Desc. Brit. Org. Rem. Dec. IV, pl. i.

The general form of this beautiful urchin is a depressed melon-shape, hollowed out above. The interambulacral segments are, centro-laterally, twice as broad as the ambulacra; the sutural pits of their dorsal surface are transversely oblong, very deep, and completely confluent, so as to appear like profound undulated furrows with steep sides; centro-laterally, the pits become smaller and disjointed, and decrease gradually in dimensions and depth towards the margin of the mouth. The interambulacral plates bear on their elevated portion each a primary tubercle, seated on a proportionately small but prominent smooth boss, and surrounded by granules, those on the dorsal plates being very numerous, and collected on a tumid surface; those on the ventral being fewer, and interspersed among small secondary tubercles, which form rings round the primaries. Of the latter, there are about ten in each half of an interambulacral space, and a like number of sutural pits. The sutural pits of the ambulacral segments are shallow, and partially confluent above. Each ambulacral plate bears near its outer or ambulacral margin a primary tubercle, equal in size to those of the interambulacra, and round this, both dorsally and ventrally, are set secondary tubercles, interspersed with granules. There are

about sixteen primary tubercles, ranged in a regular row, in each half of an ambulacral segment. The mouth is rather small in proportion to the diameter, but is larger than the genital disk. It is obscurely decagonal. The genital disk is very prominent. The five genital plates are pentangular, very tumid, and steep-sided: their sides quite smooth and excavated; their summits coarsely granulated, with two or three small secondary tubercles on their inner edge, bordering the anus. The genital pores are at the projecting angles of the plates, at their lowest and smoothest part. The eye plates are pentangular and smooth, except in the centre.

The dimensions of a fine specimen are $\frac{1\frac{1}{2}}$ ths of an inch in breadth by $\frac{5}{12}$ ths of an inch in height.

Spines apparently belonging to this species are short and stout, rapidly tapering, and grooved by about twelve rather strong and deep sulcations. The neck of the spine is surrounded by a ring of very strong crenulations.

Fine specimens from the Coralline Crag of Ramsholt are contained in the cabinets of Mr. Searles Wood, Mr. Charlesworth, and that of the Museum of Practical Geology.

2. TEMNECHINUS MELO-CACTUS. Plate I, fig. 2.

This species is equally beautiful with the last, from which it differs conspicuously in its less depressed shape, the defined and not confluent sutural pits of its upper surface, the sloping sides of the genital plates, and the more equal dimensions of the secondary tubercles.

Its general shape is a depressed, but not flattened or hollowed out spheroid, with tumid but not bulging sides. The interambulacral segments are (centrally) to the ambulacrals as 3 to 2. The sutural pits of their dorsal surfaces are strongly marked, but not so deeply hollowed out as in *T. excavatus*. They alternate regularly, and are not confluent, except very slightly so immediately near the apical disk. The pits preserve their dimensions and arrangement centrolaterally, and only become obsolete in the immediate neighbourhood of the mouth. The interambulacral plates bear on their elevated portions each a conspicuous and prominent, but not large, smooth, primary tubercle, smaller in proportion to the size of the plate, than those in the last species. It is nearly surrounded by secondary tubercles and granules, rather scattered, and most of the former nearly equal in size. These are similar on both ventral and dorsal surfaces. There are about ten primaries in each vertical row, and a like number of sutural pits. The sutural pits of the ambulacral segments, and of the interambulacral avenue-margins, are shallower, smaller, and the former more numerous. They are all distinctly defined, and not confluent. Each ambulacral plate bears on its outer half a primary tubercle nearly equal to that on an interambulacral plate, and similarly surrounded by secondary tubercles and granules. There are about fifteen of the ambulacral primaries in each vertical row. The pairs of pores in the avenues are very obscurely three-ranked, and similar in

disposition throughout; they are separated from each other by elevated ridges, and here and there a scattered granule. The mouth is much larger than the vent, and is obscurely ten-notched. The genital disk is prominent and tumid, but not abruptly sided. The flattened and prominent portion of each genital plate is covered with slightly unequal secondary tubercles or granules; its inferior and declining margin, with the space about the genital pore, is smooth. One of the genital plates bears obscure traces of the madreporiform tubercle. The ocular plates are pentagonal, and slightly rugose.

I have seen three specimens of this species, all of different sizes, from the Coralline Crag of Ramsholt. It is contained in the collection of Mr. Searles Wood. The largest example is $\frac{1}{12}$ ths of an inch in breadth by $\frac{7}{12}$ ths in height.

A single remarkable and exceptional specimen of a *Temnechinus*, larger even than the above, exhibits some striking differences, presenting the general shape of *T. excavatus*, with most of the characters of *T. melocactus*, of which, for the present, I must regard it as a variety.

3. TEMNECHINUS GLOBOSUS. Plate I, fig. 3.

This species, also from the Coralline Crag of Ramsholt, differs from the preceding in being of a globular form, having much smaller and less conspicuous sutural pits, and smaller, more numerous, and more equal tubercles. It approaches much more nearly to a true *Echinus*.

The test is very convex above, and the sides elevated and gradually rounded. The interambulacral segments are, in breadth, centrally to the ambulacrals nearly as 3 to 2. The sutural pits are shallow, confined, and placed well apart: those on the ambulacral segments are much the smaller. They all become gradually obsolete on the lower half of the test. Each plate, whether ambulacral or interambulacral, bears a small primary tubercle, surrounded by minute secondaries and intermediate granules. There are twelve primaries in each interambulacral, and fifteen in each ambulacral vertical row. The avenues of pores are nearly straight, the ridges between the pairs of pores strongly marked. The mouth exhibits very slight traces of notches. The genital plates are wanting in the two examples which I have examined. The larger specimen measures half an inch in height by eight twelfths in breadth.

4. TEMNECHINUS TURBINATUS. Plate III, fig. 11.

TEMNOPLEURUS, species of *S. V. Wood*, MS. in *Morris*, Cat. Brit. Foss., p. 60.

The only example of a *Temnechinus*, from the Red Crag, is one from Sutton. It is contained in the cabinet of Mr. Searles Wood, who long since called attention to its existence.

It is a worn specimen, much rubbed, but differs so markedly in several respects from

its congeners, that it must be regarded as distinct. The form is a depressed, but not lobed spheroid. The genital disk is less prominent, and smaller, than in the other species of the genus. The genital plates seem to have been decorated by fewer tubercles. The ambulacral segments are half the breadth of the interambulacral divisions. The sutural pits are defined, rather small, and not confluent. The primary tubercles on both ambulacral and interambulacral are much larger than in the other *Temnechini*, and surrounded by wider areolæ. There are about ten interambulacral, and thirteen, or so, ambulacral tubercles in a vertical row. The pores are arranged as usual. The specimen described measures half an inch across by rather more than a quarter of an inch in height.

In Mr. Morris's 'Catalogue of British Fossils,' a *Salenia* is mentioned as occurring, on the authority of Mr. Searles Wood, in the Coralline Crag of Sutton. The specimen alluded to has been submitted to my examination, and proves to be an immature sea-urchin, apparently the fry of one of the species of *Temnechinus*. The plates of the genital disk exhibit an appearance of pitting and rugosity which is anomalous, and strongly resembles at first glance the sculpture of the plates of *Salenia*. Hence the mistake about its generic position. There is, however, no supplementary plate, as in that genus. The traces of pits at the angles of the plate distinctly indicate its affinities with *Temnechinus*. Otherwise it might, with its large disk, have been considered a young *Goniopygus*.

Family.—CLYPEASTERIDÆ.

The urchins of this family are more or less rounded, often ovate, generally depressed. Their shells are thick, and frequently strengthened within by calcareous buttresses. Their mouths are central; their vents eccentric. They are provided with a dental apparatus of more simple structure than that characteristic of the *Echinidæ*. Their ambulacra are either distinctly petaloid and convergent, or, as in the examples about to be described, are sub-parallel. They have five genital and five ocular plates, but these are not all perforate in every case. The species found in the Crag are, with doubtful exceptions, all of the same genus with the representative of the family in the British Seas at present.

Genus—ECHINOCYAMUS, *Von Phelsum*.

Body depressed, ovate or sub-orbicular, with ambulacra which are sub-heterogeneous, their dorsal portions forming pseudo-petals with nearly parallel or slightly diverging avenues. Test thick, and strengthened within by ribs; its surface covered with small and similar tubercles, which bear rather short slender spines. Mouth round, and sub-central or central. Vent inferior. Four genital pores. A dental apparatus arming the mouth.

The species of this genus are all small, and difficult to distinguish. Almost all are tertiary. A few are found existing.

1. *ECHINOCYAMUS PUSILLUS*. Plate I, figs. 8—15.

- SPATANGUS PUSILLUS*, *Muller*. Zool. Dan., p. 18, tab. xci, figs. 5, 6.
ECHINUS MINUTUS, *Gmelin*. Linn., p. 3194.
ECHINOCYAMUS MINUTUS, *De Blainville*. Man. d'Actin., p. 214.
 — *ANGULOSUS*, *Leske* ap. *Klein*., p. 215.
 — — *Agassiz*. Mon. des Scutelles, p. 130, tab. xxvii, figs. 17, 18.
ECHINOCYAMUS ANGULOSUS, *Agassiz* and *Desor*. Ann. Sc. Nat., 3d series, tom. vii, p. 140.
 — — *Duben* and *Koren*. Kong. Vet. Akad. Hand., 1844, p. 279.
FIBULARIA ANGULOSA, *De Blainville*. Dict. Sc. Nat., tom. xvi, p. 512.
 — — *Lamarck*. An. sans Vert., vol. iii, p. 17.
 — — *Desmoulins*. Tab. Syn., p. 236.
ECHINOCYAMUS PUSILLUS, *Fleming*. Brit. Anim., p. 481.
 — — *Forbes*. Brit. Starfishes, &c., p. 175, (fig.)
 — — *Agassiz*. Mon. des Scutelles, p. 128, tab. xxvii, figs. 1—8.
FIBULARIA TARENTINA, *Lamarck*.
ECHINOCYAMUS TARENTINUS, *Agassiz* and *Desor*. Ann. Sc. Nat., 3d series, tom. vii, p. 140.

This very common, widely distributed, and very variable little urchin, is an abundant fossil in the Red Crag, especially at Alderton, Suffolk, assuming numerous changes of form, all however distinguished with facility by the position of the anus half way, or nearly so, between the mouth and the posterior margin, and by the coarse and rather conspicuous tubercles of the surface. The avenues of pores are sub-parallel, and slightly radiating. The margin is always more or less tumid, and sometimes almost swollen. The mouth is large, round, and conspicuous. The vent is also large. The exterior is strengthened by strong buttresses. In the living state, the test is covered with thick-set minute squamated spines, turning of a powdery-green colour, as the animal dies.

The principal varieties, all of which, however, pass into each other, are the following :—

- a. Normalis*, regularly oval, and tumid, (Pl. I, figs. 8—13.)
- b. Rotundus*, nearly orbicular, and tumid, (Pl. I, fig. 15.)
- c. Depressus*, rounded or ovate, much compressed above.
- d. Angulosus*, approaching an ovato-pentagonal shape, (Pl. I, fig. 11.)
- e. Triangularis*, sub-triangular, and sometimes curved, (Pl. I, fig. 10.)
- f. Tumidus*, ovate, and much swollen.

The last two forms are rare. All variations of shape between nearly completely circular, and narrowly ovate, may be taken in the one locality at the present day. A rather large

fossil example measured five twelfths of an inch in length. The breadth and height vary according to the variety.

2. ECHINO CYAMUS SUFFOLCIENCIS. Plate I, fig. 16.

FIBULARIA SUFFOLCIENCIS, *Agassiz*. Prod., p. 188.

— — *Desmoulins*. Tab. Syn., p. 244.

ECHINO CYAMUS SUFFOLCIENCIS, *Agassiz*. Monog. des Scutelles, p. 129, tab. xxvii, figs. 9—13.

— — *Agassiz and Desor*. Ann. Sc. Nat., 3d series, vol. vii, fig. 141.

The distinguishing features of this species are its compressed margin and the sub-marginal position of the very small vent. The tubercles of its surface, though coarse and conspicuous, and similarly set in deep areolæ, are slightly smaller than those of *E. pusillus*.

There are two well-marked varieties :—

a. The test of this form is broadly sub-pentagonal, much depressed, flattened out towards the margins, sub-rostrated anteriorly, hollowed out slightly beneath, and has the mouth slightly sub-pentagonal. This is the larger variety. It measures as much as four twelfths of an inch in length by three tenths in breadth, and one eighth in height.

b. The test is ovate or elongate, rather more tumid, with a round and proportionately larger mouth. The largest specimen observed, measures three twelfths of an inch in length by two tenths in breadth and one twelfth in height.

Both are found in the Red Crag of Walton on the Naze.

The description given by *Agassiz* does not touch upon the remarkable position of the vent, and is very insufficient. He states, that it comes very near *E. pusillus*, but differs in its more depressed, and broader, and more circular shape. He notices the smaller tubercles. His figure is not characteristic, and apt to mislead. It represents a specimen of the smaller variety, but the position of the vent is exhibited much too far from the margin. Since this distinguished naturalist named the specimens in Mr. Wood's cabinet, there can be no mistake about which he meant. I mention this, because the name *Suffolciencis* seems to be applied to another species in the 'Catalogue of British Fossils.'

3. ECHINO CYAMUS HISPIDULUS. Plate I, fig. 14, *a*, *b*, and *c*.

This very distinct species is more or less sub-orbicular, or sub-pentagonal, much depressed, variably convex above, usually tumid at the margins, and slightly concave in the region of the mouth. The entire surface is covered with very minute tubercles and granules, so as to give it a hispid appearance to the naked eye. The boundaries of the plates are indicated by very distinct groovings. The ambulacral pores are very indis-

tinctly indicated; the avenues are sub-parallel, slightly radiating. The anus is exceedingly small in proportion to the size. It is placed at two thirds of the distance from the mouth to the margin. The strengthening buttresses are well developed internally.

The very small anus, its position, and the very minute and comparatively scattered tubercles, easily distinguish this from any of its congeners.

There are some small ovate specimens which appear to belong to a variety of this species.

A large example measures five twelfths of an inch in length by very nearly the same in breadth, and one eighth in height.

It occurs in the Coralline Crag of Ramsholt.

Mr. Morris in his 'Catalogue,' gives the Coralline Crag of Suffolk, as the formation in which *Echinocyamus Suffolciensis* occurs: this species was probably intended.

4. *ECHINOCYAMUS OVIFORMIS*. Plate I, figs. 17 and 18.

The test is ovate, tumid for the genus, remarkably rounded at the sides, and depressed above. Its surface is covered with rather coarse tubercles. The mouth is placed on a plane, or slightly concave ventral surface; it is very large. The vent, though small in comparison, is large in proportion to the dimensions of the test, and is placed on the inferior slope of the terminal tumid margin, a position which at once distinguishes the species from all our other British *Echinocyami*.

This small species, of which I have examined as many as twelve examples, in the cabinet of Mr. Searles Wood, has an immature aspect. Its characters are, however, unmistakeably peculiar. It is from the Coralline Crag of Sutton.

The largest specimen measures two tenths of an inch in length by two twelfths in breadth and one tenth in height.

Genus—*ECHINARACHNIUS*, *Van Phelsum*.

Discoid, depressed urchins, with open and not converging dorsal ambulacra. Their mouths are small and circular. The vent is small and marginal. They have four genital pores.

One species, if not two, inhabit the North Atlantic now. It is with much doubt that I refer the following fossils to this genus.

1. *ECHINARACHNIUS*? *WOODII*. Plate II, fig. 5 and (same species?) fig. 6.

The fragment of a much depressed, slightly convex ovate urchin, concave underneath, with a sub-central mouth. Represented in Plate II, fig. 8.

Also the small fragment of an ovate, much depressed, slightly convex urchin, with parallel ambulacra, a terminal vent, overhung by a projection of the back, the whole surface covered by close-set, equal, minute tubercles within impressed areolæ, (Plate II, fig. 6,) possibly belonging to a species of *Echinarachnius*.

They are both from the Red Crag. I know no urchins, living or fossil, which can be compared with these curious fragments, of which I would strongly urge collectors to seek for even the smallest portions, in order that some more certain clue to their relations may be discovered. It is not impossible, indeed, that the one represented in fig. 6 may be distinct from that delineated in fig. 8.

They are both from the Red Crag.

Family—SPATANGIDÆ.

These are heart-shaped urchins, more or less elongated and bilateral, having petaloid dorsal ambulacra, a terminal anus, and an excentric mouth, covered by a more or less projecting lip. They have no dental apparatus. The apical disk is perforated by four genital and five ocular holes, but there is the usual number of plates going to its composition. The genera are distinguished from each other by the presence, absence, and arrangement of the fascioles, which are circumscribed bands of minute spines, and by the presence or absence of large tubercles bearing primary spines. No genus of this family has been noticed in strata older than those of the Cretaceous epoch.

Genus—SPATANGUS, *Klein*.

Body depressed, cordate, with heterogeneous ambulacra converging to a genital disk, which is dorsal and entire; superior portion of the lateral ambulacra petaloid. Anterior ambulacrum in a sulcus. Anus terminal; a caudal fasciole, but no dorsal one. Four genital pores. Mouth bilabiate, excentric, placed anteriorly on the ventral surface in front of an escutcheon. Spines slender, curved, the primaries longer than the others, and borne on large tubercles, which are especially developed on the anterior portion of the dorsal surface.

There is no true *Spatangus* known from strata lower than Tertiary. Most of the existing species are natives of the North Atlantic.

1. SPATANGUS PURPUREUS. Plate II, fig. 3.

SPATANGUS PURPUREUS, *Muller*, Zool. Dan. Prod., 2850, and Zool. Dan., tab. vi.

— — — *Leske ap. Klein*, p. 238, tab. 43, figs. 3—5; (see, also, *Enc. Meth.*, pl. 157, figs. 1—4.)

SPATANGUS PURPUREUS, *Lamarck*, Anim. sans Vert., 1st ed., vol. iii, p. 29; 2d ed., vol. iii, p. 324.

— — *Fleming*, Brit. Anim., p. 480.

— — *Blainville*, Man. d'Actin., p. 202, pl. xiv, figs. 1—3.

— — *Forbes*, Brit. Starf., p. 182, (with figure.)

— — *Agassiz and Desor*, Ann. Sc. Nat., 3d ser., vol. viii, p. 6.

— — *Düben and Koren*, Kong. Vet. Akad. Hand., 1844, p. 285.

ECHINUS PURPUREUS, *Gmelin*, Lin., p. 3197.

— LACUNOSUS, *Pennant*, Brit. Zool., iv, p. 69, pl. 35 and 76.

Identical with this well-known living species, (of which *Spatangus meridionalis* of Risso, and *S. spinosissimus* of Desor, appear to be varieties,) is one of which about half the test is preserved, in the collection of Mr. Searles Wood, from the Coralline Crag of Ramsholt. It differs from our ordinary British form in being slightly more carinate at the sides of the anterior ambulacral sulcus, a character in which it approaches to the more southern varieties, and at the same time agrees with ours in shape and degree of depression; being, indeed, if anything, slightly more depressed. The antero-lateral ambulacra are slightly narrower, the primary tubercles quite as numerous. The specimen is not in such a state as to warrant a more minute description.

2. SPATANGUS REGINA? Plate II, fig. 2.

SPATANGUS REGINA, *Gray*, Ann. Nat. Hist., 2d ser., vol. vii, p. 130?

In the collection of Mr. Brown, of Stanway, there is a large fragment of a true *Spatangus*. It is the greater portion of the upper surface, from the margin of the vent to the anterior extremity, which latter is unfortunately, however, concealed by adhering matter. One of the postero-lateral, and part of one of the antero-lateral ambulacra, are exposed. The postero-lateral ambulacrum is lanceolate, with a gently flexuous outline. The two avenues converge suddenly. There are about 26 pairs of pores in each avenue. Each pair is lodged in a deep and well-defined sulcus. The number of pairs of pores in the antero-lateral ambulacra cannot be made out. The whole of the surface is closely set with miliary granules. On the ambulacral spaces there are no primary tubercles, but in the centre of the postero-lateral and postal interambulacral spaces, the only ones exposed, there are groups of nearly equal primary tubercles forming curved assemblages. Between them, on the interambulacral spaces, there are curved depressions in the test. The whole body seems to have been broad and depressed. It measured rather more than four inches in length by rather less in breadth.

Another fragment of a true *Spatangus*, also from the Coralline Crag, exhibiting the cordate anterior extremity, the granulated groove of the anterior ambulacrum, tumid and slightly angulated cheeks, and the portion of the anterior surface in front of the mouth, may have belonged to another species, or to only a more tumid form of the same.

Genus—BRISSUS, *Klein*.

Body oval or oblong, tumid; dorsal ambulacra sub-petaloid, circumscribed by a peripetal fasciole; tubercles of dorsal surface all similar; anus terminal, supra-marginal; caudal extremity with a sub-anal fasciole.

The living species of *Brissus* are chiefly tropical. The fossil representatives of the genus are entirely tertiary.

1. BRISSUS SCILLÆ, *Agassiz*. Plate II, fig. 4.

Scilla, De Corp. Mar., pl. iv, figs. 2 and 3.

BRISSUS SCILLÆ, *Agassiz* and *Desor*, Ann. Sc. Nat., 3d ser., tom. viii, p. 13.

SPATANGUS (BRISSUS) PLACENTA, *Philippi* in *Erichson's Archiv.* for 1845, pt. 1, p. 349?

This sea-urchin, one of the largest and most remarkable of all those found fossil in the Crag, varies much in shape, some specimens being oblong, some wide and ovate; the former are usually high, and strongly subcarinated on the back; the latter more depressed, but all have the apex strikingly excentric, and the anterior extremity abruptly truncated. The greatest width of the body is nearly on a line with the terminations of the postero-lateral ambulacra. The tubercles of the back are numerous and closely set, and increase gradually in size in the antean region and towards the apex. The lateral ambulacra are narrow, somewhat linear in shape, and deeply impressed, showing on the surface as four deep radiating furrows, two of which, the antero-lateral ones, stand at right angles to the longitudinal diameter of the shell, whilst the other two, the postero-laterals, are directed obliquely backwards, and form an acute angle at their apical terminations. The latter are a little longer than the former, and contain rather more pairs of pores, the respective numbers in each row being from 27 and 30 to about 30 and 35. The centro-ambulacral space is smooth, or nearly so, in the lateral ambulacra; but in the odd, or antean ambulacrum, which, instead of being impressed and sub-petaloid, is linear and plane, or even slightly elevated, it is regularly and minutely granulated, the large granules or small tubercles forming boundary rows. In the lateral ambulacra, the ridges separating the pairs of pores are minutely granulated. The genital disk, usually obscured in fossil specimens, has four genital holes, the two posterior ones largest, and five eye-perforations, remarkable for their peculiar structure. The peripetal fasciole is very distinctly marked. In front of the antero-lateral ambulacra, it includes a wide somewhat semicircular space, its foremost and central portion crossing the shell at a little below half its height. From this point, tracing its course along each side, it runs with a slight angularity to about two thirds of the distance between the antean and the end of the antero-lateral ambulacrum, before meeting which it makes a single strongly-marked incurved flexure, in this respect

differing from *Brissus carinatus*, the fasciole of which makes two incurved flexures in this region. It then winds closely round the end of the antero-lateral ambulacrum, and ascends rapidly between it and the postero-lateral one, making a deep but wide flexure somewhat truncated at its upper part; it then curves down, following closely the bounds of the postero-lateral ambulacrum, round which it winds and crosses the posterior interambulacral space, with an arched curve not so deeply in-turned as the lateral curves are. The anal extremity of the test is perpendicularly truncated (a character also distinctive between this species and *B. carinatus*), the anus lenticular and large, and placed rather low, the sub-anal or caudal fasciole is broadly subcordate, truncated below. The mouth is transversely semicircular, with a slightly overhanging and prominent lip. The oral ambulacra are subtriangular and radiating. The tubercles of the post-oral spinous space are subequal and radiating.

Length of specimen (presented by E. H. Bunbury, Esq., M.P.) in the Museum of Practical Geology, 4 inches and $\frac{3}{12}$ ths. Breadth, 3 inches. Height, 2 inches and $\frac{2}{12}$ ths.

This remarkable urchin is found in the Coralline Crag. Mr. Searles Wood and Capt. Alexander have taken it, as well as Mr. Bunbury. It varies much in proportion, but is distinctly identical with Scilla's species, which lives in the Mediterranean, and occurs fossil in the miocene of Malta. I purposely omit all references to Lamarck, as there is sad confusion about this *Brissus* and its allies.

Genus—AMPHIDETUS, Agassiz.

Body cordate, tumid, with heterogeneous ambulacra converging to a genital disk, which is dorsal and entire; superior portion of the lateral ambulacra trumpet-shaped. Anus terminal. A caudal and an intra-petal fasciole, the latter conspicuous on the back, and shield-shaped. Four genital pores. Mouth bilabiate, excentric, and placed anteriorly on the ventral surface, in front of an escutcheon. Spines slender, curved, graduated; no prominent and conspicuous primary tubercles on the dorsal surface.

The living species of this genus are all from the North Atlantic, and its arms. The fossil forms are all from the Upper Tertiaries.

1. AMPHIDETUS CORDATUS. Plate II, fig. 1.

ECHINUS CORDATUS, Pennant. Brit. Zool., vol. iv, p. 69, figs. 34 and 75.

SPATANGUS PUSILLUS, Leske. Page 230, tab. xxiv, figs. c, d, e, and tab. xxxviii, fig. 5.

— ARCUARIUS, Lamarck. An. sans Vert., vol. iii, p. 31, and 2d edit., vol. iii, p. 328.

— — De Blainville. Man. d'Actin., p. 201.

— CORDATUS, Fleming. Brit. An., p. 480.

AMPHIDETUS CORDATUS, *Forbes*. Brit. Starf., p. 191.

— — *Agassiz and Desor*. Ann. des Sc. Nat., 3d series, tom. viii, p. 11.

— — *Duben and Koren*. Kong. Vet. Akad. Handl., 1844, p. 285.

Body broadly cordate, elevated posteriorly, depressed, and declining anteriorly; sub-angulated at junction of sides and base. All the lateral ambulacra exterior to the ovate coffin-shaped fasciole, the two rows of pairs of pores composing each converging gradually towards their outer terminations. Plates of dorsal surface closely set with minute tubercles, occupying squamated areolæ. On the under surface they are larger, and not so closely packed. Anal extremity steep and high: the vent in a slight depression, in its upper part semi-circled by a fasciole, which is incomplete above; a sub-cordate caudal fasciole below it. Post-oral spinous space broadly lanceolate. Oral ambulacra occupying smooth avenues. Spines fine, curved, slender, fragile, sub-spathulate, well preserved on the specimen described. Length, $1\frac{9}{12}$ ths of an inch; breadth, $1\frac{7}{12}$ ths; height at caudal extremity, 1 inch.

In the Coralline Crag.

ORDER.—ASTERIADÆ.

The true star-fishes have lobed bodies, more or less depressed, and prolonged into radiating arms, more seldom reduced to a pentangular disk. The whole of the upper surface is covered by a coriaceous skin, studded with a reticulation of calcareous plates, and often bearing superficial spines, tubercles, and pedicellariæ. There is always a madreporiform tubercle present; and generally a vent. In the centre of the ventral surface is the mouth, whence radiate to the extremity of the rays or arms as many ambulacra as there are lobes. In these, the suckers are lodged, ranged in ranks of twos or fours, bordered by peculiar and often spinigerous plates. The only well-defined fragment of a Crag star-fish is a member of the Family URASTERIÆ, in which there are always present four rows of suckers in each ambulacral groove.

URASTER, *Agassiz*.

Body deeply lobed, or produced into five (rarely more) slender arms, spinose above. Margins not bordered by conspicuous plates. Suckers four-ranked.

1. URASTER RUBENS. Plate II, fig. 7, *a* and *b*.

ASTERIAS RUBENS, *Retz*. Vetensk. Acad. Handl., vol. iv, p. 236.

— — *Linnaeus*. S. N., 1099.

- ASTERIAS RUBENS, *Muller*. Zool. Dan. Prod., p. 2830.
 — — *Lamarck*. An. sans Vert., 1st ed., vol. ii, p. 512; 2d ed., vol. iii, p. 160.
 — — *Blainville*. Man. d'Actin., p. 239, pl. xxii, A, B.
 — GLACIALIS, *Pennant*. Brit. Zool., vol. iv, p. 60, No. 54.
 — — *Fleming*. Brit. An., p. 487.
 STELLONIA RUBENS, *Agassiz*. Prod.
 — — *Forbes*. Wern. Mem., vol. viii, p. 121.
 URASTER RUBENS, *Forbes*. Brit. Starf., p. 83, (with figure.)
 ASTERACANTHION RUBENS, *Muller and Troschel*. Syst. der Asteriden, p. 17.

To the commonest of our native star-fishes, I refer a very remarkable and rare fragment from the Red Crag, in the possession of Miss Alexander, who kindly communicated it for description and representation.

It consists of a number of ambulacral and other ossicula of an arm of a *Uraster*, in very perfect preservation. The ambulacral bones are linear, geniculated at their inner extremities, and combined to form a ridge. From their outer terminations spring some of the confluent chains of ossicles, that went to the strengthening of the superior arched integument of the arms.

The specimen is represented in fig. 7, *a*, of the natural size. Ossicula, probably derived from the same, or a closely allied star-fish, have been found by Mr. Searles Wood. For a description of the *Asterias rubens*, the reader may consult the 'History of British Star-fishes.'

ORDER.—CRINOIDEA.

The feather-stars and lily-stars, as the members of this order are popularly styled, differ from all other Echinodermata, in having their reproductive organs attached to the pinnacles of radiating jointed arms. Their viscera are included within a cup of calcareous plates, which, either in the younger stages of growth or throughout life, as appears to have been the case with most of the fossil species, was borne on the summit of a jointed columnar stem.

The few remains of *Crinoids* found in the Crag belong to the Genus *Comatula*, one of those types of which the adults are free.

The buccal orifice is in the centre of the visceral disk; the vent at the extremity of a tube proceeding from it.

COMATULA, *Lamarck*.

Cup simple, of a single piece, bearing five bifurcating pinnated arms above, and a number of chelate jointed filaments attached to its under surface, except in the centre, where there is a disk to which, in its early stage, the extremity of a column was attached.

Although the remains of *Comatulæ* found in the Crag are exceedingly fragmentary, and consist only of minute and much injured cups, they are sufficiently well marked to enable us to pronounce with certainty on their affinities, and also to speak with confidence as to their distinctness from any described forms. They have, curiously enough, relations more near to Indo-Pacific types than to any found now in the Atlantic and its arms.

At the present time, two species of this genus inhabit the British Seas.

1. COMATULA WOODWARDI. Plate I, fig. 20.

Three little cups, each of which measures rather less than three millimetres across by about one in height, contained in the collection of Mr. Searles Wood, and discovered by that naturalist in the Coralline Crag of Sutton, have belonged to a species of *Comatula*.

They are deeply and widely excavated above, the breadth of the excavation occupying more than a third of the total width, so as to give a narrow aspect to the superior border of the cup. This margin is broken up by rather broad radiating furrows. The under surface is convex; centrally, it is smooth or minutely punctated, and plane; at the sides, it is sloping, swollen, and pitted by two closely set circles of impressed and rather large sockets for filaments, ten in each circle.

2. COMATULA BROWNII. Plate I, fig. 19.

I have given this name, in honour of Mr. John Brown, of Stanway, to the cup of a very distinct *Crinoid* from the Coralline Crag, of which two specimens have been communicated from Sutton by Mr. Searles Wood.

The largest measures two twelfths of an inch in diameter by two millemetres in height. The excavation in the centre of the cup, superiorly, is rather more than a millemetre in diameter, and one half the breadth of the distance between it and the flattened marginal portion. The under-side exhibits but slight traces of the central disk, the alternating circles of tentacular scars occupy the remainder of its slightly convex surface.

3. *COMATULA RANSOMI*. (See *Woodcut below*.)

A number of cups of a third species of *Comatula* have been found by Mr. Searles Wood, in the Coralline Crag of Sutton. It probably bore a nearer resemblance to our existing British forms of this genus than any of its fossil allies.

The largest of these disks measures one twelfth of an inch in diameter by rather more than one millimetre in height. The excavation occupies more than a half of the total width, rendering the marginal sulcated portion very narrow. The under surface is conic and reversely cup-shaped, depressed at the base, and marked by the sockets of numerous feelers, which were ranged in about three rows on the sides, the largest circle of about fifteen pits.



ECHINODERMS OF THE LONDON CLAY.

SUB-KINGDOM. — RADIATA.

CLASS.—ECHINODERMATA.

Family.—CIDARITIDÆ.

THE members of this family are distinguished among those which have the vent and mouth at opposite poles, and the former aperture surrounded by the genital and ocular plates, by the pairs of pores in their avenues being ranged in true single file, and by their narrow ambulacra, upon which are no primary spines. They have a well-developed dental apparatus. Of all the families of *Echinidea* this is the most ancient, certain palæozoic sea-urchins appearing to be truly species of *Cidaris*.

Genus—CIDARIS, *Lamarck*.

Test turban-shaped, thick, the ambulacral areas very narrow, and bearing secondary tubercles and spines only; its interambulacral segments broad, ornamented with large and few perforated tubercles, placed on smooth or crenulated bosses, and bearing variously shaped strong spines, always different in form and sculpture from the secondary spines. Pores of the avenues in strict single file. Oral membrane covered with imbricated scales. Eye-plates and genital plates all perforated.

The existing species of *Cidaris* are distributed through the seas of all regions, but the majority are congregated within the tropics. The number of mesozoic species was much more considerable. Of tertiary forms our knowledge is not very precise; and unfortunately, as in the instance about to be noticed, confined to their spines only in too many cases.

1. *CIDARIS WEBSTERIANA*. Plate III, fig. 4.

I have given this name to the spines of a *Cidaris* collected by Mr. Edwards at Barton, the only relic of the genus as yet noticed in British tertiaries. Their shape is stout and cylindrical, slightly swelling out at their halves, ornamented by about twelve longitudinal rows of rounded and nearly equal tubercles, the grooves between being very narrow and very minutely striated. Between the collar of the spine and the commencement of the ridges of tubercles, is a shallow well-defined nearly smooth neck. The collar is not crenulated; from within it projects the nipple-like deeply hollowed articular surface. A large example measures $\frac{1.0}{1.2}$ ths of an inch in length by $\frac{1}{10}$ th in diameter at its most tumid part.

In the Museum of Practical Geology; presented by F. E. Edwards, Esq.

Family.—ECHINIDÆ.

Genus—ECHINUS, *Linnæus*.

(See page 2.)

1. *ECHINUS DIXONIANUS*. Plate III, fig. 3.

As yet no body, or even plate, of any true *Echinus* has been found in British Eocene strata. A single spine belonging to this genus has, however, been procured by Mr. Edwards at Barton. It evidently formed part of the armature of a large sea-urchin. It is ornamented with about twenty-four depressed, rather narrow longitudinal ribs, separated from each other by very fine grooves, and at their lower parts as if doubled, owing to the presence of a finer groove down the centre of each rib. The collar of the spine is raised, tumid, and crossed by the grooves. The neck is pyramidal and truncated, with a rather small articular surface. The spine itself is imperfect; but when entire, may have measured three quarters of an inch in length by one eighth in breadth at the collar.

Genus—ECHINOPSIS, *Agassiz*.

Body spheroidal, inflated, with homogeneous ambulacra converging above to a genital disk, composed of five perforated genital plates alternating with five perforated oculars, and forming a ring around an apical vent. Mouth central and inferior. Tubercles perforated, as in *Diadema*, but borne upon plain and not crenulated bosses.

This genus is intermediate between *Echinus* and *Diadema*. The known species are all fossil, and either from the upper part of the Cretaceous strata, or from Eocene beds.

1. *ECHINOPSIS EDWARDSI*. Plate III, fig. 2.

One of the most interesting of the Echinoderms from British Eocene strata is this, obtained by Mr. Edwards at Brackelsham, and also in the uppermost marine beds at Barton. Two specimens have been found, one showing the upper surface and plates in great perfection, and the other much less perfect, displaying, nevertheless, the general shape, although much crushed. The interambulacral spaces are to the ambulacra as 3 to 1. Each interambulacral row of plates is composed of about twelve in longitudinal series. Each plate bears a single perforated primary tubercle on the summit of a gently prominent smooth boss. On its inner side is a rather prominent secondary tubercle, and about its base a somewhat irregular circle of granules. The general arrangement of the primary tubercles on the interambulacral spaces is such as to make them appear as two close rows set rather widely apart, thereby contrasting with the closely placed rows of primaries in the ambulacral segments, where, in like manner, there is a single tubercle on each plate. The avenues are broad in consequence of the very oblique transverse series of pairs of pores, falling regularly into ranks of threes, an arrangement noticed as occurring in this genus only in the *Echinopsis Gacheti* of Desmoulins, from the tertiary of Blaye, a large species as yet undescribed and unfigured. The disk of our *Echinopsis* is destroyed and the mouth obscured. Associated with it are very slender spines, squamose, with circles of appressed spinules, and in one instance spatulate at the tip. These, judging from their analogy with the spines of the allied genus *Astropyga*, probably belonged to our urchin.

Echinopsis Edwardsi measures half an inch in breadth by three tenths of an inch in height.

Genus—CÆLOPLEURUS, Agassiz.

Body a depressed spheroid, of five ambulacral and five interambulacral segments, all spinigerous, below and laterally, but becoming naked towards their summits, where they converge to a disk of five perforated genital, and as many perforated very large ocular plates, forming a ring around an apical vent. Tubercles imperforate and bosses simple. Mouth very large. Pores disposed in single file throughout.

The species of this genus, enumerated by Agassiz, are all Eocene fossils, and are remarkable for singularity and beauty. Unfortunately our only English one is found in the condition of pyritous casts, mostly in the London clay of Sheppey, and presents but very imperfect indications of the peculiarities of its organisation.

1. *CÆLOPLEURUS WETHERELLI*. Plate III, fig. 1.

ACROSALENIA, species of, *Morris*. Cat., p. 47.

Depressed, orbicular, convex above, plain below, with somewhat compressed sides. Ambulacral areas very narrow, smooth above, ornamented at their inferior portions by a few large alternating tubercles. Interambulacral spaces also quite naked above, and similar, bearing few large alternating tubercles in their lower portions. The tubercles of lower parts of the segments occupy the whole of the base around the very large mouth. The avenues are broad, though composed of pores ranged in single file, this arrangement becoming obscure near the mouth. The apical disk is remarkable for the very large ocular plates. In consequence of the bad condition of the tests, both tubercles and pores are often obliterated. In Mr. Wetherell's collection, is a specimen apparently of this species from Highgate Archway, with the spines imperfectly preserved. They were long, slender, and longitudinally grooved, the ridges few and granulated.

Most of the numerous examples of this urchin have been procured in Sheppey by Mr. Bowerbank. The largest example measures half an inch in diameter by a quarter of an inch in height.

Family.—SPATANGIDÆ.

(See page 13.)

Genus—HEMIASTER, *Desor*.

Inflated urchins with heterogeneous ambulacra, distinctly petaloid in their dorsal portions, and often lodged in depressed spaces. They have terminal vents and excentric bilabiate mouths. The petals of the back are circumscribed by a slightly undulated fasciole. There is no sub-anal or intrapetal fasciole. There are no large primary tubercles mingled with the very uniform secondaries that cover the plates. All the known species are from Cretaceous or Eocene strata. They are very similar to each other in general aspect, so that it is requisite to have recourse to critical distinctions in defining the species.

1. *HEMIASTER BOWERBANKII*. Plate III, fig. 6.

This little urchin is very tumid, much elevated posteriorly, declining anteriorly. Its highest portion is just above the truncated anal extremity. The contour is obcordate, with an obscure tendency to a hexagonal outline. The dorsal ambulacra are widely petaloid, very unequal, and all lodged in deep excavations. The antero-lateral ones are twice as long as the postero-laterals. The latter are broadly ovate, and have about eight pairs

of pores in each row. The antero-laterals are oblong-ovate, and have about twelve pairs of pores in each row. The hollowed-out portion of the odd ambulacrum is ovato-lanceolate, and longer than the antero-laterals by a third. The elevated spaces between the petals are narrow, and as if pinched up. The sides are very prominent. The caudal extremity is perpendicularly truncate. The vent is small, and placed very high up. The ventral surface is nearly plane, with rounded sides. The mouth is transversely oval, and scarcely bilabiate.

A large example measures half an inch in length by the same breadth, and four tenths of an inch in height. As the test is not preserved in any specimen that I have seen, I have not been able to make out the details of the plates, tubercles, and fasciole.

Mr. Bowerbank has found many specimens in the London Clay of Sheppey.

2. HEMIASTER? PRESTWICHII. Plate III, fig. 5, *a*, *b*, *c*.

Resembling the last in general aspect, but growing to a much larger size, and differing in important particulars. It is very tumid, and suborbicular or slightly pentagonal in outline. The postero-lateral interambulacral space is most elevated, and the back gradually declines towards the frontal extremity. The ambulacra are subpetaloid, and almost at the surface of the test, the odd one only being lodged in a shallow depression. The antero-lateral petals are two and a half times as long as the postero-laterals. The latter are narrowly oblong, and in a moderate sized example present six pairs of pores in each row. The antero-laterals are narrowly lanceolate or subparallel, and composed of about twelve pairs of pores in a row. The caudal extremity is obtuse, and in its middle portion perpendicularly truncate. The ventral surface is somewhat convex. The mouth is small. The plates that are preserved are covered with slightly scattered small equal tubercles, the interspaces being granulated. I cannot detect any traces of fascioles, and am strongly inclined to believe that this urchin is really a species of *Macropneustes*, but, until better specimens are found, do not like to venture on the introduction of that characteristically Eocene genus into the British lists.

Most of the specimens of this curious sea-urchin are deprived of all traces of their tests. They have been found in the London Clay proper, especially at Sheppey, by Mr. Bowerbank. The dimensions of a perfect, though not one of the largest examples, are as follows :

Length, $0\frac{6}{10}$ ths of an inch. Breadth the same. Height very nearly the same.

3. HEMIASTER BRANDERIANUS. Plate III, fig. 8.

The remains of this rather large species are much compressed and broken down, so that it is difficult to determine its original form. It appears to have been broadly obcordate and elevated, though not over much posteriorly. It attains to three times the

dimensions of the *H. Bowerbankii*. The dorsal ambulacra are conspicuously petaloid, and all lodged in shallow depressions. The antero-laterals are rather less than twice as long as the postero-laterals. The latter are ovate, with truncate extremities, and have from twenty to twenty-four pairs of pores in each row. The antero-laterals have about thirty pairs in a row. These numbers refer to full-grown examples. Younger ones have fewer pores. The plates are covered by squamose elevations, bearing nearly uniform tubercular bosses. The peripetal fasciole is rather broad, and but very slightly undulated. The odd ambulacrum is studded with minute granules.

I have not seen the under side of this species; nor, though the test is partially well preserved in two instances, is the anal extremity in such a state as to enable me to say with certainty whether there may not be a caudal fasciole. In such case the species must be referred to *Brissus*.

There are two varieties, which may eventually prove to be distinct species. The one is from Barton (Mr. Bowerbank), and the other from Haverstock Hill (Mr. Edwards). The former is represented in Plate III, figs. 8, *a*, *b*, and *c*, and the latter in fig. 8, *d*.

Genus—EUPATAGUS, *Agassiz*.

More or less ovate and sub-depressed urchins, often of considerable dimensions, with heterogeneous ambulacra distinctly petaloid or subpetaloid in their dorsal portions. The odd ambulacrum is lodged in a more or less deep furrow. The dorsal petals are circumscribed by a distinct fasciole, and there is another well-marked sub-anal or caudal fasciole. The dorsal plates within the peripetal fasciole bear, besides the ordinary tubercles, large primary ones, in the manner of *Spatangus*. The mouth is excentric and bilabiate, the vent terminal.

The species of this genus at present known are either living, or from Eocene strata. The existing forms inhabit the Australian seas. No fossil belonging to it has hitherto been observed in Britain.

1. EUPATAGUS HASTINGIÆ. Plate III, fig. 7.

The body of this remarkable and elegant sea-urchin is regularly ovate, and, though much compressed in the specimens, must have been gently convex. The ambulacra are petaloid, with long petals of lanceolate shape, and of equal lengths. Of the lateral ambulacra the two anterior stand nearly at right angles to the axis of the test, the two posterior form an acute angle. The odd one is nearly parallel-sided. None of them are lodged in sulci, but all at the surface of the test. There are about twenty-four pairs of pores in each row on the lateral petals. The petals are circumscribed by a narrow, very distinct fasciole, not sinuated at the sides. The plates are covered with scattered granules

and secondary tubercles. Within the fasciole the interambulacral spaces bear conspicuous primary tubercles, scattered. These are very small, perforated, and placed on elevated bosses surrounded by a broad excavated areola. Beneath, in the neighbourhood of and behind the mouth, the primaries are more numerous, and regularly arranged. The caudal fasciole is distinctly seen.

The length of a specimen in the Museum of Practical Geology is one inch and six tenths, by rather more than an inch and a quarter in breadth.

This fine addition to our British lists was discovered in the clays at Barton, during the researches of the Geological Survey. I have dedicated it to the Marchioness of Hastings, whose indefatigable researches among the Tertiaries of the cliffs at Hordwell and Barton have contributed greatly to our knowledge of the organic remains of Eocene strata in Great Britain.

I have compared this species with excellent examples of Biaritz *Eupatugi*, kindly communicated by Mr. Pratt; from all of them, however, it differs essentially.

Genus SCHIZASTER, *Agassiz*.

Body cordate, depressed, broad; apical disc placed far back; ambulacra lodged in very deep depressions, unequal, surrounded by a peripetal fasciole, from which a lateral supplementary fasciole proceeds on each side towards the anus, and passes beneath it.

1. SCHIZASTER D'URBANI. (*See Woodcut at the end of this Memoir.*)

Mr. D'Urban has communicated a sea urchin from the Barton beds in Alum Bay, apparently belonging to this genus, but retaining so few fragments of the test that it is impossible to pronounce upon its true position with certainty.

Its outline was broadly cordate. As in many *Schizasters*, the postero-lateral ambulacra are short compared with the antero-laterals. The former are oblong and contain about eighteen pairs of pores in each series. The latter are broadly lanceolate and arcuated, and have about twenty-seven pairs of pores, lodged in rather broad transverse grooves in each series. Both antero- and postero-laterals are placed in deep depressions of the test. Between the former and the odd or anterior ambulacrum, the test is swollen and pinched, as is usual in this genus. The odd ambulacrum is long and broad, seated in a deep steep-sided, flat-based sulcus. The other characters of the species are not sufficiently clear for description. Fragments of two other specimens occur in the same slab with that here described. It was brought to me too late for being included in the plate, and has consequently been figured in a vignette at the close of this memoir.

Genus—SPATANGUS, *Klein*.

(See page 13.)

1. SPATANGUS OMALII. Plate III, fig. 9.

SPATANGUS OMALII, *Galeotti*, Mém. sur le Const. Geol. de la Province de Brabant, p. 191, pl., supp., fig. 1.

Mr. Edwards has found at Barton fragments of a true *Spatangus*. These, on comparison with an authentic example of the *Spatangus Omalii* of Galeotti, brought by Sir Charles Lyell from Eocene strata in Belgium, prove to be, almost beyond a doubt, identical with that species. I have figured the fragments with a restoration founded on the Belgian *Spatangus*.

The body was rather broadly cordate, and depressed above. The fragments preserved show that the elevation of the dorsal surface was moderately uniform, and that the margins were rather compressed. The dorso-lateral petals were lanceolate, with truncate extremities. They were placed quite at the surface of the test, and their pores were connected by grooves. The surface of the plates appears as if punctated and minutely granulated. Within the anterior and lateral interambulacral spaces, are a few scattered large and deep areolæ surrounding elevated bosses, bearing the primary tubercles. These were absent from the hinder extremity of the test. The ventral surface was plane, or slightly concave, and bore numerous large primary tubercles with thin areolæ. The mouth and vent are not preserved.

The best preserved fragment indicates a length of six tenths of an inch, and a breadth of rather less dimensions.

ORDER.—ASTERIDEA.

(See page 17.)

Family.—ASTERIÆ.

The star-fishes of this group have regularly depressed flattened bodies, their upper surfaces covered with paxillæ or coronated spines, and their margins bordered by a regular double series of plates. They have no anal pore.

Genus—ASTROPECTEN, *Linck*.

Body stellate, few (five) rayed; rays flat on both sides, regular; surface of the skin dorsally, and upper surfaces of the rays covered with paxillæ. No vent. Ambulacra bordered by spines, and furnished with two rows of suckers. Margins of the rays bordered by a double row of conspicuous plates.

1. *ASTROPECTEN CRISPATUS*. Plate IV, fig. 2.

ASTERIAS, sp., *Ansted*, *Geology*, vol. ii, p. 66, woodcut.

ASTROPECTEN CRISPATUS, *Forbes*, *Mem. Geol. Surv. Great Britain*, vol. ii, pt. 2, p. 479:
and *Fig. and Desc. of Brit. Org. Rem.*, dec. i, pl. 3, fig. 3.

This is the commonest of Eocene star-fishes, and specimens from the London Clay of Sheppey are preserved in many cabinets. It has long attracted notice, but was first figured, without a specific name, by Professor Ansted. It seems to have been of a firmer and less brittle habit than its brethren, since it is the only one of our London Clay species that presents anything near completeness of shape.

It has five triangularly lanceolate rays radiating from a broad central disk. The pyritous condition in which the examples are always found, prevent our making clearly out the details of its ornamentation, but apparently the dorsal surface was studded with rather large paxillæ. The margins of the arms are bordered by very numerous, narrow, closely-set oblong plates, varying from 25 to above 35 on each side of the arms of the larger specimens examined. These gently decline outwardly, where they meet with similar under-plates, so that the edges of the arms seem as if somewhat compressed. All the marginal plates bear at their outer and upper edges short obtuse lanceolate spines. There are indications of ossicula of considerable size, and probably spinigerous, bordering the narrow avenues. The greatest diameter, from tip to tip of rays, in one of the most perfect specimens which I have seen (in the cabinet of Mr. Bowerbank), is two inches and a quarter. The breadth of the disk in this example is one inch. The species grew to a larger size.

2. *ASTROPECTEN ARMATUS*. Plate IV, fig. 1.

ASTROPECTEN ARMATUS, *Forbes*, *Mem. Geol. Surv. Great Britain*, vol. ii, pt. 2, p. 479;
and *Fig. and Desc. of Brit. Org. Rem.*, decade i, pl. 3,
fig. 4.

The specimen originally described and figured of this species is still the only one known. It is the greater part of the under surface of a single arm. The marginal ossicula bear narrow elevated ridges, upon which are impressions indicating the sockets of spines. On their outer sides are long, slender spines, perfectly preserved. Indications may be perceived of fasciculi of short spines, in threes or fours, on the ossicles bordering the edges of the avenues. It is very distinct from any other Eocene star-fish as yet observed. The fragment measures nine twelfths of an inch in breadth at its base, and one inch three twelfths in length. The spines and plates are respectively about three twelfths of an inch in length. It was procured in the Clay of Sheppey.

3. *ASTROPECTEN* ? *COLEI*. Plate IV, fig. 3.

Among some fragments of fossil star-fishes obtained by the Earl of Enniskillen in the London Clay of Sheppey, and now in the Museum of Practical Geology, is one belonging to a very distinct type from any described, but unfortunately too imperfect to afford certain indications of its generic affinities. I have placed it provisionally under *Astropecten*. It may, however, be a *Luidia*.

It consists of portions of two, if not four rays, evidently originally, as the parallelism of their sides indicates, of very considerable length. Their margins are bordered by two series of narrow plates, each bearing an elevated crest or ridge, with very steep sides. These ridges bear traces of pits for the attachment of spines. Those of the inferior plates are gently curved, and become broader and flatter towards the avenues. Within them, towards the avenues, are broader polygonal plates, with strongly marked spine-sockets. The spines that lie about are stout at their bases, and taper gradually to an obtuse extremity. Complicated arrangements of small spines bordered the avenues. The diameter of one of these arm fragments is eight twelfths, and the thickness five twelfths of an inch.

Genus—*GONIASTER*, *Agassiz*.

The star-fishes of this genus have pentagonal bodies covered by tessellated ossicula, which are usually ornamented with numerous granules, and sometimes spines. They have a central mouth in the midst of the five radiating avenues below, and an excentric vent on their dorsal disk. They are all of a depressed form, and their ray and body-margins are bordered by two series of large plates, forming their edges. The suckers in their avenues are ranged in two rows.

1. *GONIASTER STOKESII*. Plate IV, fig. 6.

GONIASTER STOKESII, *Forbes*. Mem. Geol. Survey of Great Britain, vol. ii, pt. 2, p. 475.

Fig. and Descr. of Brit. Org. Rem., dec. i, pl. 3, fig. 1.

Next to the *Astropecten crispatus*, this is the commonest of the species of star-fishes of which remains occur in the London Clay of Sheppey. It has never, however, been found in a perfect condition, and it is just possible that more than one species may be confounded under the name.

The general form appears to have been that of a pentagon, with greatly produced and slender angles. The upper surface was covered by unequal polygonal ossicles, all punctated for the insertion of minute granules. The edges of the body and rays were bounded by a double series of cuboidal, stout, steep-sided marginal plates, with very obtuse and gibbous, but not spiniferous or truly tuberculated angles. The surfaces of

these plates are pitted all over, indicating that they were covered by minute polygonal granules. The marginal plates were exceedingly numerous, and towards the extremities of the rays became so approximated, that the rows of each side of an arm nearly or quite touched. The under-surface was covered by large punctated flat polygonal ossicles closely set, and along the margins of the avenues are stouter and more convex ones that bore short spines and were grooved. Towards the slender extremities of the arms these occupy all the space between the marginal plates.

Fine fragments of this star-fish are preserved in the Museum of Practical Geology, to which they were presented by Mr. Charles Stokes, and in the cabinet of Mr. Bowerbank.

2. GONIASTER MARGINATUS. Plate IV, fig. 4.

GONIASTER MARGINATUS, *Forbes*. Mem. Geol. Surv. Great Britain, vol. ii, pt. 2, p. 475 ;
and Fig. and Descr. of Brit. Org. Remains, dec. i, pl. iii, fig. 2.

The only known fragment of this star-fish is the one described in the first decade of 'British Organic Remains,' and procured by Mr. Charles Stokes from the London Clay of Sheppey.

It consists of five superior, and as many inferior marginal plates. The upper ones are large, oblong, regularly declining on their outer sides, and of comparatively little altitude. Their surface is but slightly convex, thickly punctured all over, and bordered laterally by a distinct elevated rim. The inferior plates are similar, but have even more elevated margins, and the rim is continued on them across their outer sides. The dermal ossicles are small and punctate. The length of the fragment is three eighths, and its breadth less than two eighths of an inch.

3. GONIASTER TUBERCULATUS. Plate IV, fig. 5.

In the Museum of Practical Geology there is a fine fragment of a ray, which, whilst it resembles in many particulars *Goniaster Stokesii*, exhibits characters that entitle it to be regarded as a portion of a distinct species. The part preserved measures one inch and four tenths in length, by one inch three tenths in breadth at its base, and seven tenths of an inch towards its extremity. The dorsal surface appears to be covered by small irregular ossicula. The margin is flanked by two series of nearly equal cuboidal plates, with steep sides, and slightly rounded summits; these are remarkable for bearing a large areolated tubercle, one on each, at their obtuse external edges. These tubercles are larger on the upper than on the under plates. The whole surface of each plate, except the tubercle, is closely pitted, and on some are preserved the small closely-set polygonal granules that occupied the pits. The dermal ossicles of the ventral disk are rather large. The avenues are bordered by strong square plates, bearing short, obtuse, stout spines.

The specimen was procured by the Earl of Enniskillen from the London Clay of Sheppey. I have seen other fragments of the same species.

ORDER.—OPHIURIDEA.

The Brittle-stars have orbicular or pentagonal bodies, covered above with a skin, which is either naked, squamose, or spinous. Below they have a central mouth, from which five long, simple, flexible arms, protected by plates and spines, radiate far beyond the disk. At the base of each ray there are two brachial plates studding the dorsal surface; they have no vent. The genital pores open below. Their arms are furnished with cirri.

OPHIURA, *Lamarck*.

In the Brittle-stars of this genus the dorsal surface of the body is covered with smooth scales or plates. The interbrachial shields at the bases of the arms are conspicuous, and there is a fringe of minute spinules on the margins of the small plates above them immediately appressed on the arm-bases; these latter are inserted into the disk. The inferior intermediate plates are hollowed out at their sides, and of conspicuous dimensions. The mouth is bordered by projecting ossicles, edged by a single row of minute obtuse papillæ. The side plates of the rays bear appressed spines.

1. OPHIURA WETHERELLI. Plate IV, fig. 7.

OPHIURA, sp. *Wetherell*, Geol. Proc., i, p. 417.

— *Morris*, Cat. Br. Fos., p. 55.

Some years ago Mr. Wetherell put on record an Eocene *Ophiura* from near Hampstead, and has since found at Highgate, in concretionary masses, numbers of small *Ophiuræ* all of one species. They have orbicular bodies covered above by rather large plates, arranged more or less concentrically, and by large triangular, sub-parallel, brachial shields. Traces of the small clasping scales bearing a comb of spinules, may be seen in one example. The under side exhibits clear traces of the peculiar arrangements of the genus to which it belongs. The arms are about three times as long as the diameter of the disk, and are gently tapering. The central scales of their upper surfaces change rapidly from broadly quadrangular to a sub-triangular shape, and eventually become partially overlapped by the large lateral scales; each of the latter bears four or five tapering, rather short spines. On the under side of the ray the lateral scales meet and join nearly to their extremities, where a small triangular central scale is interposed.

The breadth of a disk is three-twelfths of an inch.

I cannot find sufficient distinctions between this and some well-preserved fragments of an *Ophiura*, discovered by the Marchioness of Hastings in the High Cliff at Barton, to warrant the considering of the latter, at present at least, as a distinct species.

ORDER.—CRINOIDEA.

(See page 18.)

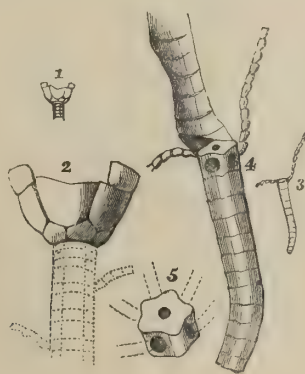
Genus—CAINOCRINUS, *Forbes*.

(From *καivos*, new, and *κρινον*, a lily.)

Cup basin-shaped, constituted of a pelvis formed out of five free plates, alternating with five large ascending radials. Column obscurely pentagonal, furnished with articulated ramules, arranged in distant whorls. Joints with stellated articular surfaces.

I have instituted this genus for the reception of a very remarkable Crinoidal body, in the collection of Mr. Bowerbank. The proportions and shape of the cup are such, that at first glance it has more the aspect of a Palæozoic than of a Tertiary Crinoid. It bears also considerable resemblance to some of the less normal forms of *Millericrinus*. It is however, a member of the same group with the *Pentacrinus*. I should not be at all surprised, if some of the columns described here under the name of *Pentacrinus* were eventually to turn out portions of *Cainocrini*.

1. CAINOCRINUS TINTINNABULUM.



[Fig. 1. Nat. size.—2. The cup and upper joints of column magnified.—3. Portion of a column of the natural size.
4. The same magnified.—5. A joint, with the sockets for the ramules.]

Of this curious Echinoderm, the greater part of the cup with a portion of the column attached, are preserved in the collection of Mr. Bowerbank, who procured them from the London Clay, at Hornsey. Mr. Wetherell has two fragments of columns, found near Copenhagen House, which appear to belong to the same species.

The cup measures $\frac{1}{8}$ th of an inch in height by two tenths in diameter. The column attached is rather less than one twelfth of an inch in diameter. The cup is formed of five rather large and gradually ascending pelvic plates, crowning a slender column, which does

not thicken or swell out at the point of junction. The five plates of the pelvis alternate with five large, slightly convex, ascending primary radials, which bear the first arm-plates large also, but of only half the height. All the plates are smooth. The arms, &c., are destroyed. The column is uncompressed, very equal in its proportions, very smooth, with slightly undulating joints, whose sutures appear slightly curved externally, and whose articular surfaces are roughly radiated. The perforation is very small. The whorls of ramules are very distant; their sockets are large and deeply impressed. They are slender, but strongly jointed.

Genus—PENTACRINUS, *Miller*.

Cup very shallow, constituted of a pelvis composed of a single piece formed out of five anchylosed plates, alternating with five primary radials. Column more or less distinctly pentagonal; furnished with articulated ramules. Joints with stellated articular surfaces.

1. PENTACRINUS SUBBASALTIFORMIS. Plate IV, figs. 8, 9, 10.

PENTACRINUS SUBBASALTIFORMIS, *Miller*. Nat. Hist. of Crinoidea, p. 140.

— — *Wetherell*. Trans. Geol. Soc., London, 2d series,
vol. v, pt. 1, p. 136, pl. viii, fig. 4.

— — *Austen*. Monog. Rec. and Fos. Crinoidea, p. 122,
pl. xvi, fig. 2.

— DIDACTYLUS, *Auide D'Orbigny*. Mém. Soc. Géol. France, 2^{de} ser. vol. ii,
pl. v, fig. 18?

Miller, in his famous work upon *Crinoidea*, proposes the name of *Pentacrinites subbasaltiformis* for the columns of a Crinoid, found by Mr. James Sowerby in the London Clay at White Conduit House, Islington, and mentions that similar columns occur at Richmond and at Kensington. He remarks that "these columns much resemble in size and shape those of *Pentacrinites basaltiformis*, but have the angles more rounded. From their exhibiting no marks of muscular corrugation at their exterior surface, and the joints being of uniform thickness, I apprehend the fragments before me to be full grown columnar portions." It was figured by Mr. Wetherell in the illustrations to his paper entitled "Observations on a Well dug at Hampstead Heath," and since by Mr. Austin, in his "Monograph of Recent and Fossil Crinoidea."

Numerous fragments of stems have been found. These vary from round to very obtusely pentangular, and from five lined to five grooved along this length. The joints are of equal dimensions, and are plane and quite smooth externally. The articular surfaces present rounded crenated lobes. At intervals, ramules are given off opposite, or very nearly opposite, each other, disturbing the symmetry of the joints from which they spring. In the example represented, Plate IV, fig. 8, the diameter of the joints is one fourth of an inch, and their altitude one tenth of an inch.

In Mr. Wetherell's collection are several fragments of the arms and pinnules, but none in a condition sufficiently good to enable us to make out the details of the head. The arm-joints were rather strong, and equal, rounded dorsally, and smooth. The pinnules were tapering, and about seven times as long as the arms are broad.

This species has been found abundantly in several localities of the London Clay; as at Hampstead, Hornsey, Copenhagen Fields, Chalk Farm, Sheppey, and Herne Bay. The fragments of stems vary much in degree of rotundity and indications of lobation. Young examples are more distinctly five-lobed than old specimens.

2. PENTACRINUS SOWERBII. (See *Woodcut*, p. 36.)

PENTACRINUS SOWERBII, *Wetherell*. Trans. Geol. Soc., London, 2d series, vol. v, p. 132, pl. viii, fig. 4.

— — *Austen*. Monog. of Recent and Fossil Crinoidea, p. 123, pl. xvi, fig. 3, *a* and *b*.

Mr. Wetherell found, along with *Pentacrinus subbasaltiformis*, in the London Clay near Highgate, the columns of a *Pentacrinite* with unequal joints, which he rightly regarded as distinct, and has figured under the above name.

The joints are more strongly angled than in the last; the angles very much rounded. Mr. Wetherell remarks, that there are two obscure tubercles on each of the larger joints. In one specimen there are two small joints between each large one. The articular surfaces are regularly five-lobed; the lobes rounded, with acute angles between them.

3. PENTACRINUS OAKESHOTTIANUS. (See *Woodcut*, p. 36.)

In Mr. Wetherell's extensive collection of Eocene Pentacrinite stems, there are several fragments of columns, which seem to have belonged to a different species from either of the two named kinds, and though small, appear to be distinct from young examples of *P. sub-basaltiformis*, which they most nearly resemble. The joints are equal, acutely pentangular, with a shallow groove between the angles. The articular surfaces are regularly stellate. In a portion of a column four tenths of an inch in length by one tenth in breadth there are twelve joints.

The specimens were found near Chalk Farm.

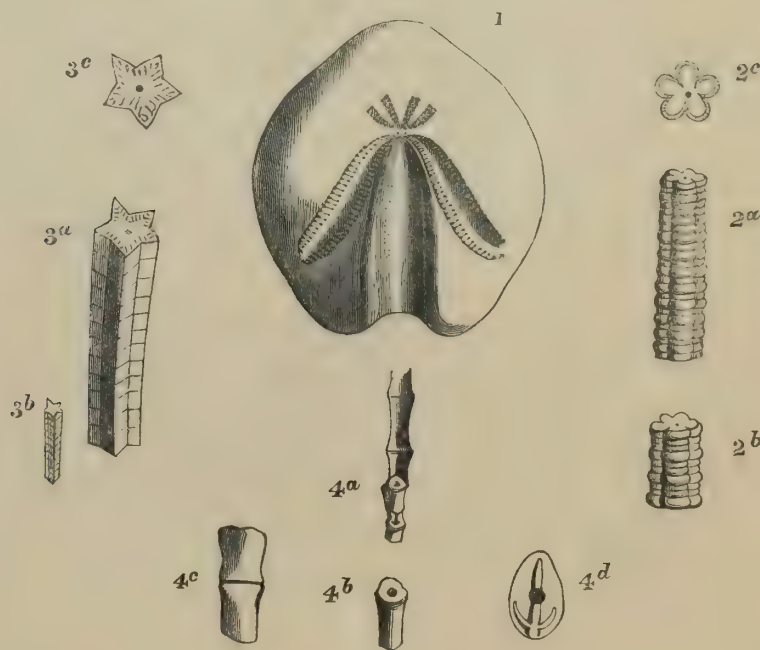
Genus BOURGUETICRINUS, *D'Orbigny*.

A genus of the Apiocrinite group of Crinoids, having a slender column without ramules, and composed of graduated joints, with their articular surfaces plain, or marked by a transverse ridge, but never stellate. The summit of the stem is enlarged and pyriform, though small, and is composed of two sets of pieces. The cup is very shallow.

1. BOURGUETICRINUS LONDINENSIS. (*See Woodcut.*)

Mr. Wetherell has found fragments of a Crinoid in the London Clay at Copenhagen House, evidently belonging to a species of this genus. The joints are smooth, thick, elliptical, rounded and slightly swollen at either one or both their extremities, so as to present something of a dice-box shape. They are nearly equal, and their swellings alternate in an oblique manner. In the longest portion of a stem as yet discovered, measuring an inch and a quarter, there are ten articulations. Each of these is, at its broadest portion, one eighth of an inch in its widest diameter. The articular surfaces had a longitudinal ridge, in the manner of those of the chalk *Bourgueticrinus ellipticus*.

Much interest attaches to the discovery of this Crinoid. Hitherto the genus to which it belongs has been known from several species found in the chalk, one found in the Eocene tertiaries of Biaritz, and one still living in the seas of the Antilles, but of which, like that before us, the joints only are known. No British Eocene species had hitherto been discovered.



EXPLANATION OF THE FIGURES.

1. SCHIZASTER D'URBANI.—2 *a* and *b*. Column of PENTACRINUS SOWERBII; 2 *c*. Articular surface of joint.—3 *a* and *b*. Column of PENTACRINUS OAKESHOTTIANUS, magnified and of the natural size; 3 *c*. Surface of a joint.—4 *a* and *b*. Joints of the column of BOURGUETICRINUS LONDINENSIS; 4 *c*, joints magnified; and 4 *d*, an imperfect articular surface.

PLATE I.

ECHINODERMS OF THE CRAG.

Fig.

1. *TEMNECHINUS EXCAVATUS*, *p.* 6.

1*a.* Upper surface.

1*b.* Side view.

1*c.* Ambulacral and interambulacral plates and avenues.

1*d.* A spine.

2. *TEMNECHINUS MELOCACTUS*, *p.* 7.

2*a.* Upper surface.

2*b.* Side view.

3. *TEMNECHINUS GLOBOSUS*, *p.* 8.

3*a.* Upper surface.

3*b.* Side view.

3*c.* Ambulacral and interambulacral plates.

4. *ECHINUS LAMARCKII*, *p.* 2.

4*a.* Side view.

4*b.* Ambulacral and interambulacral plates, and avenues.

4*c.* A spine.

5. *ECHINUS LYELLII*, *p.* 4.

5*a.* Fragment showing ambulacral and interambulacral plates.

5*b.* A portion magnified.

5*c.* A spine.

6. *ECHINUS CHARLESWORTHII*, *p.* 5.

6*a.* Upper surface.

6*b.* Side view.

6*c.* Ambulacral and interambulacral plates.

7. *ECHINUS HENSLOVII*, *p.* 5.

7*a.* Upper surface.

7*b.* Side view.

7*c.* An interambulacral and two ambulacral plates.

Fig.

8—13. *ECHINOCYAMUS PUSILLUS*, *p.* 10.

- 8*a.* Upper surface.
- 8*b.* Under surface.
- 8*c.* Side view.
- 8*d.* Highly magnified.
- 8*e.* Spines magnified.
- 9. Another specimen, under surface.
- 10*a.* Upper surface.
- 10*b.* Side view.
- 11. Under surface.
- 12. Interior, dorsally.
- 13. Interior ventrally.

14. *ECHINOCYAMUS HISPIDULUS*, *p.* 11.

- 14*a.* Upper surface.
- 14*b.* Under surface.
- 14*c.* Side view of a variety.

15. *ECHINOCYAMUS PUSILLUS*, var. *ROTUNDUS*.

16. *ECHINOCYAMUS SUFFOLCIENSIS*, *p.* 11.

17, 18. *ECHINOCYAMUS OVIFORMIS*, *p.* 12.

19. *COMATULA BROWNII*, *p.* 19.

- 17*a.* Upper surface.
- 17*b.* Under surface.
- 17*c.* Side view.

20. *COMATULA WOODWARDI*, *p.* 19.

- 20*a.* Upper surface.
- 20*b.* Under surface.
- 20*c.* Side view.

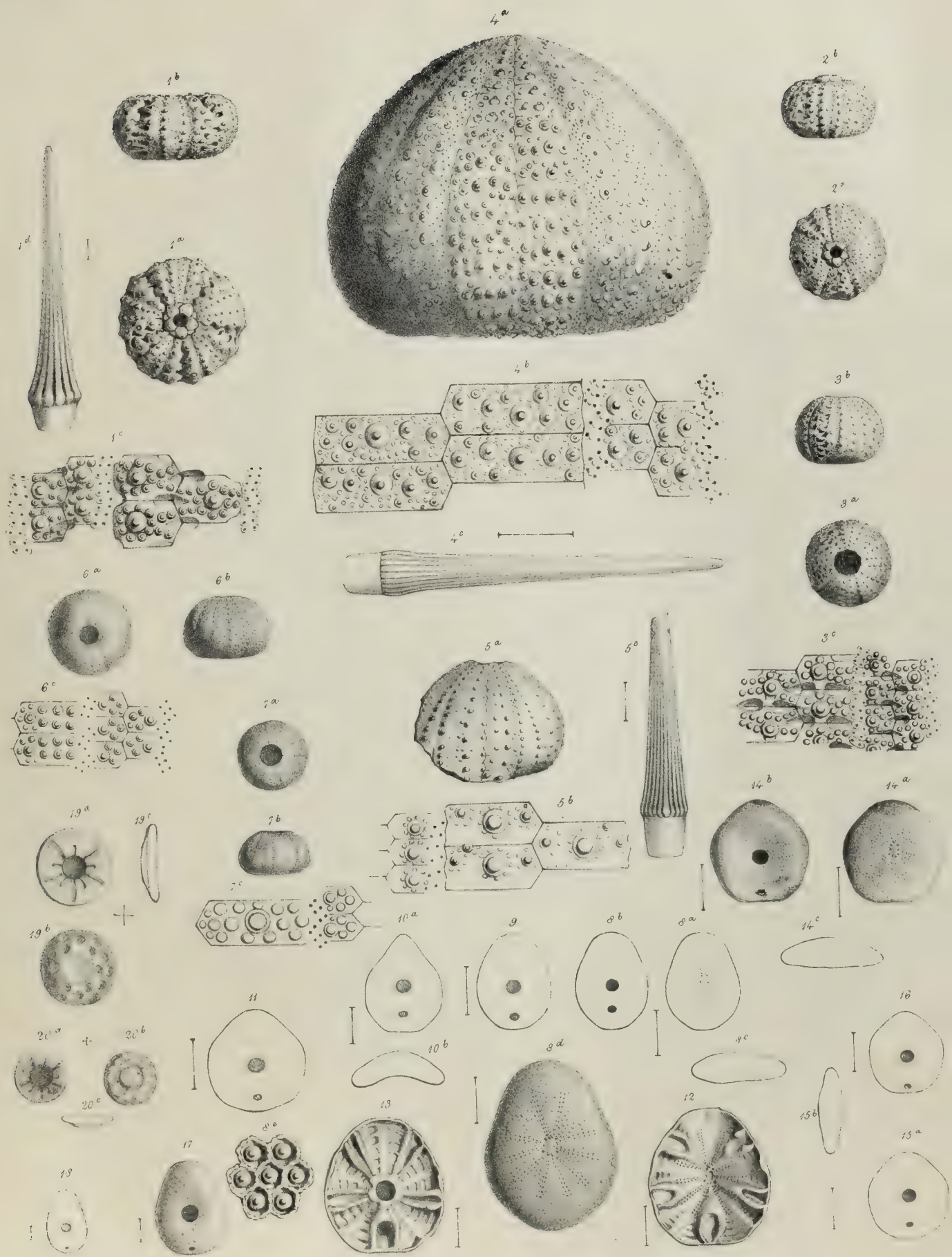




PLATE II.

ECHINODERMS OF THE CRAG.

Fig.

1. AMPHIDETUS CORDATUS, *p.* 16.

1*a.* Upper surface.

1*b.* Under surface.

2. SPATANGUS REGINÆ, *p.* 14.

3. SPATANGUS PURPUREUS, *p.* 13.

1*a.* Upper surface.

1*b.* Tubercles and spines.

4. BRISSUS SCILLÆ, *p.* 15.

1*a.* Upper surface.

1*b.* Caudal extremity.

1*c.* Fasciole, &c.

- 5 and 6. ECHINARACHNIUS WOODII, *p.* 12.

7. URASTER RUBENS, *p.* 17.

7*a.* Specimen entire.

7*b.* A portion enlarged.

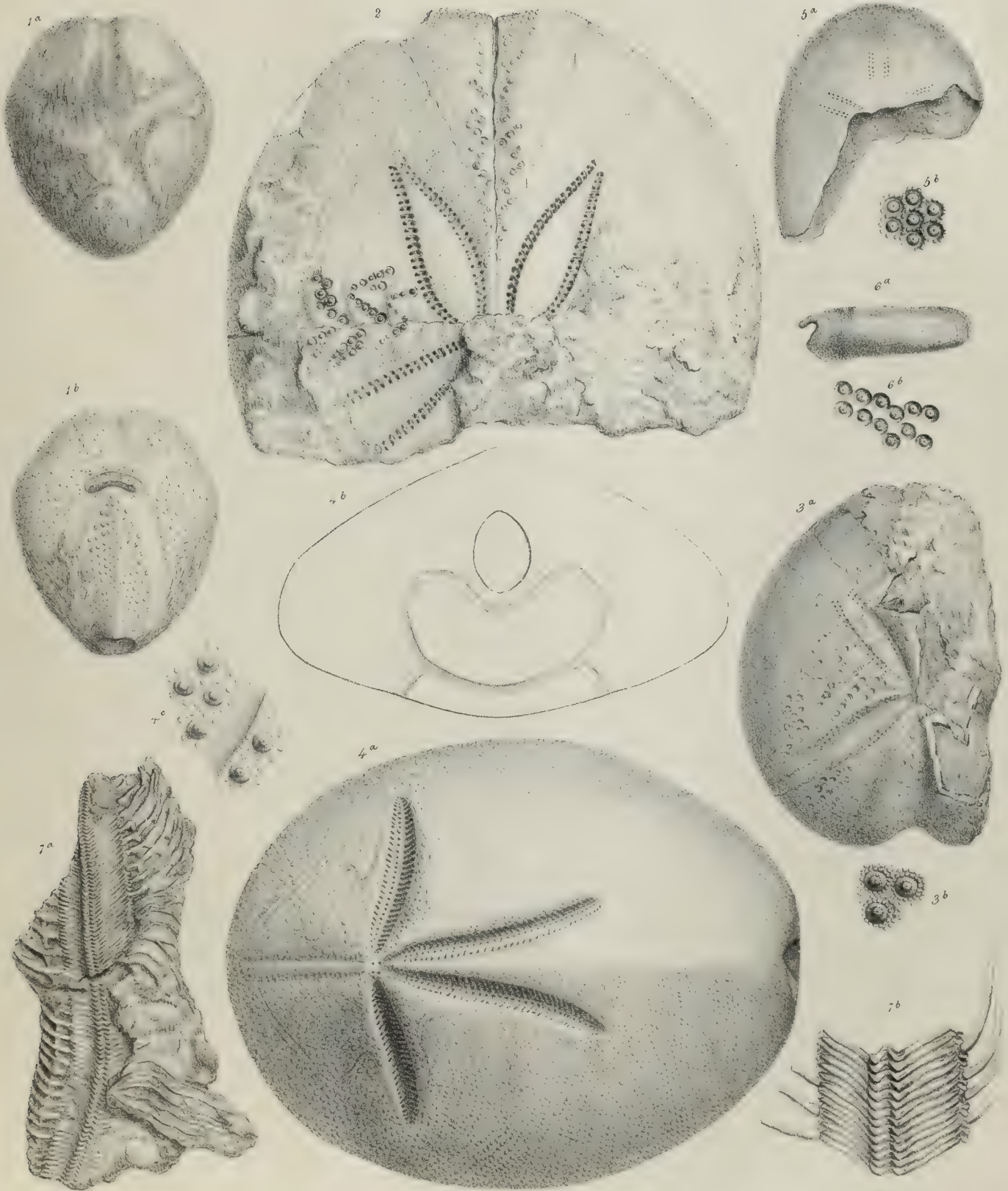


PLATE III.

ECHINODERMS OF THE LONDON CLAY.

Fig.

1. *CÆLOPLEURUS WETHERELLI*, *p.* 24.

- 1*a.* Upper surface.
- 1*b.* Under surface.
- 1*c.* Profile.
- 1*d.* Profile magnified and restored.
- 1*e.* Genital disk.
- 1*f.* Specimen with spines.
- 1*g.* Spine, and magnified portion.

2. *ECHINOPSIS EDWARDSI*, *p.* 23.

- 2*a.* Upper surface of natural size.
- 2*b.* The same magnified and restored.
- 2*c.* Plates and pores.
- 2*d.* A primary tubercle.
- 2*e.* A spine.
- 2*f.* Portions of middle and extremity of spines.

3. SPINE OF *ECHINUS DIXONIANUS*, *p.* 22.

4. SPINE OF *CIDARIS WEBSTERIANUS*, *p.* 22.

5. *HEMIASTER PRESTWICHII*, *p.* 25.

- 5*a.* Upper surface.
- 5*b.* End view.
- 5*c.* Side view.
- 5*d.* Upper surface magnified and restored.

6. *HEMIASTER BOWERBANKII*, *p.* 24.

- 6*a.* Upper surface.
- 6*b.* Under surface.
- 6*c.* End view.

Fig.

7. *EUPATAGUS HASTINGLÆ*, *p.* 26.

7*a.* Upper surface.

7*b.* Anal extremity, showing the caudal fasciole.

7*c.* Portion of the odd ambulacrum.

7*d.* and *e.* Spinigerous tubercles.

8. *HEMIASTER BRANDERIANUS*, *p.* 28.

8*a, b, c.* Portions of the Barton variety.

8*d* and *e.* Example from Haverstock Hill, magnified and restored.

9. *SPATANGUS OMALII*, *p.* 28.

9*a.* Fragments from Barton.

9*b.* Restoration of upper surface.

9*c.* Tubercles and their areolæ.

ECHINODERMS OF THE CRAG.

10. *ECHINUS MELO*? *p.* 4.

11. *TEMNECHINUS TURBINATUS*, *p.* 8.

11*a.* Upper surface.

11*b.* Side view.

11*c.* Ambulacral and interambulacral plates.

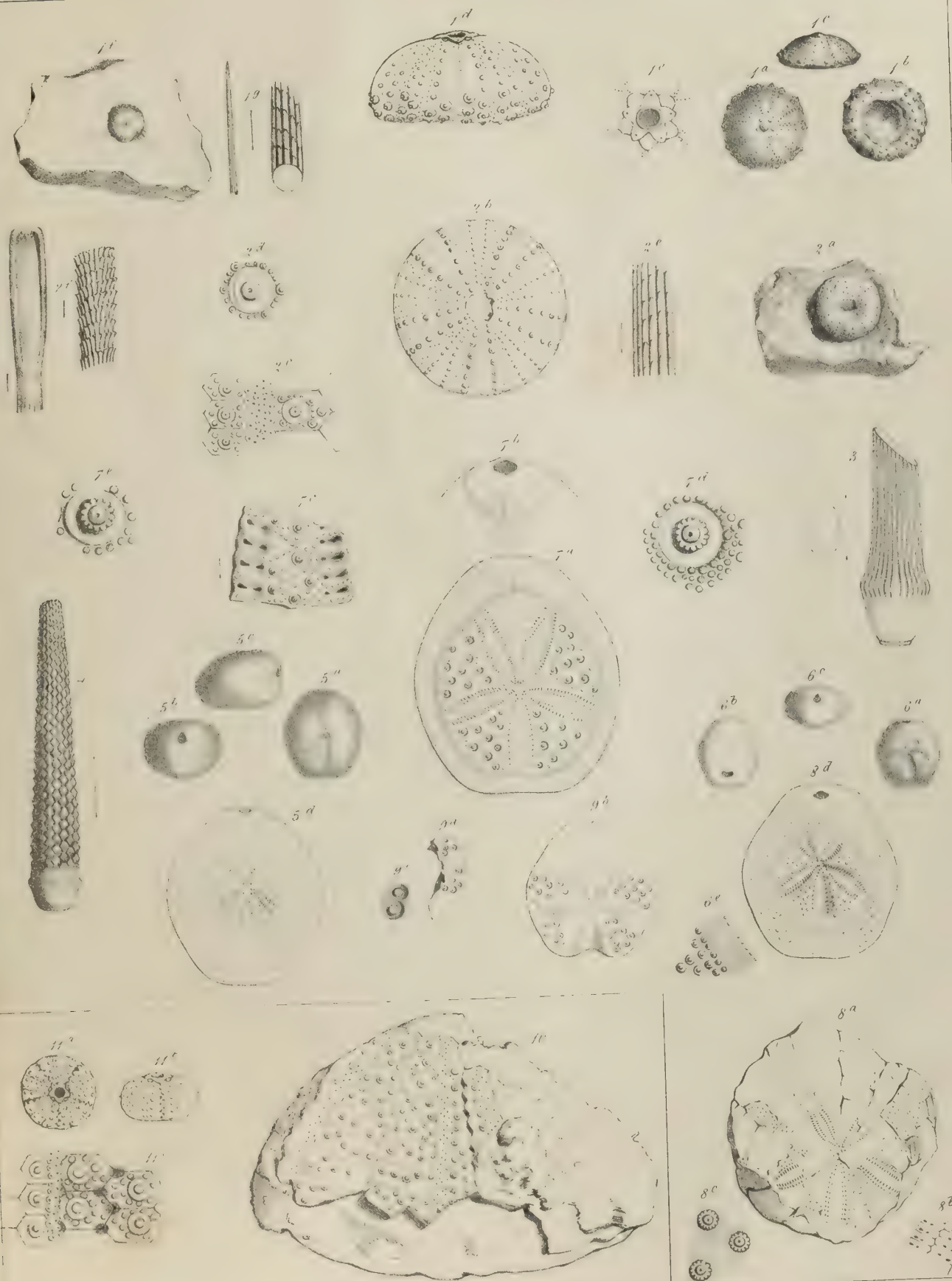
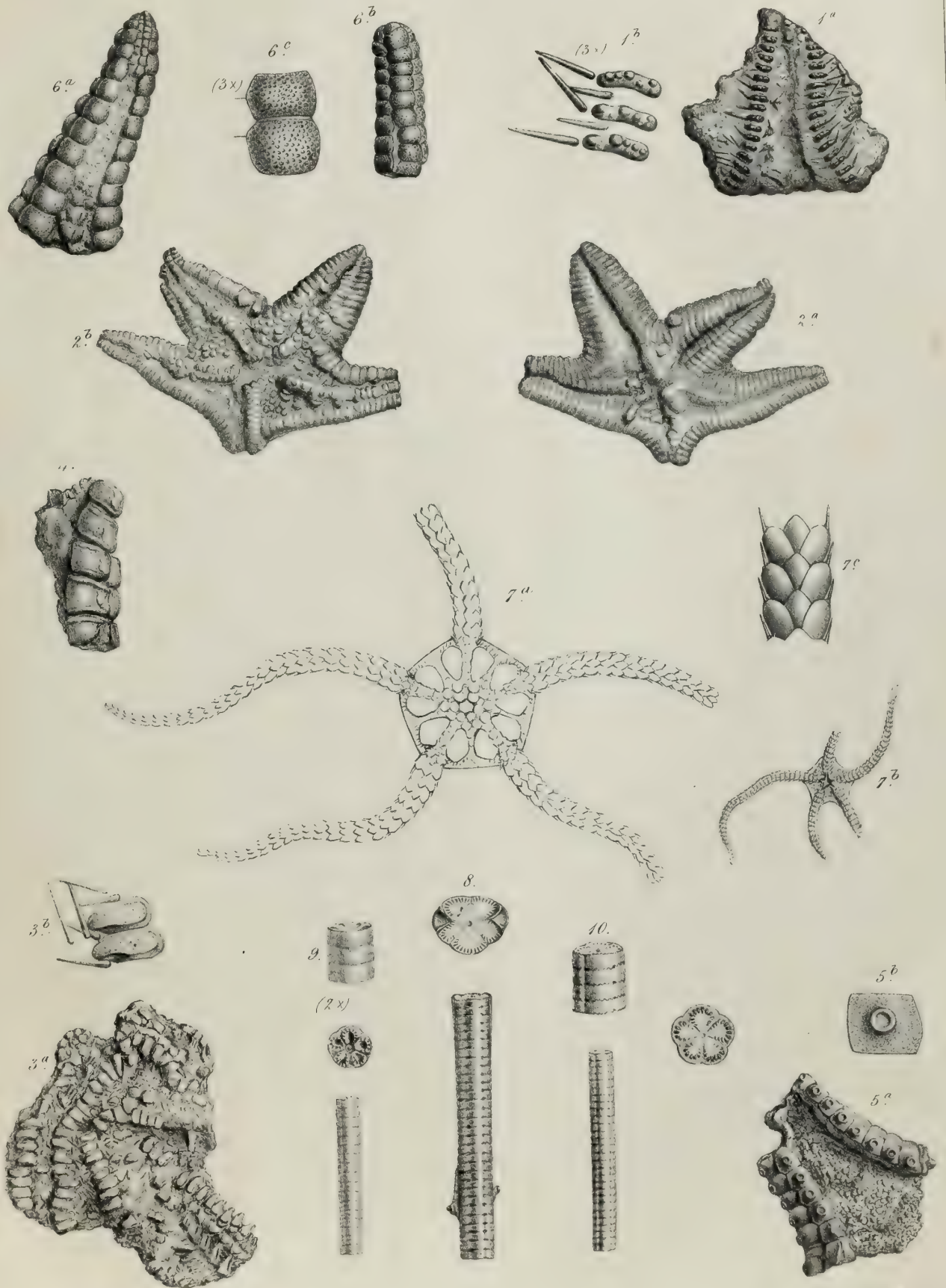


PLATE IV.

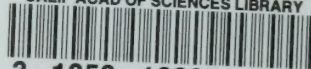
ECHINODERMS OF THE LONDON CLAY.

Fig.

1. *ASTROPECTEN ARMATUS*, *p.* 29.
 - 1*a.* Natural size of specimen.
 - 1*b.* Marginal plates and spines, magnified.
2. *ASTROPECTEN CRISPATUS*, *p.* 29.
 - 2*a.* Upper surface.
 - 2*b.* Under surface.
3. *ASTROPECTEN* ? *COLEI*, *p.* 30.
 - 3*a.* Specimen of natural size.
 - 3*b.* Plates and spines.
4. *GONIASTER MARGINATUS*, *p.* 31.
5. *GONIASTER TUBERCULATUS*, *p.* 31.
 - 5*a.* Natural size of fragment.
 - 5*b.* A marginal plate magnified.
6. *GONIASTER STOKESII*, *p.* 30.
 - 6*a* and *b.* Portions of rays.
 - 6*c.* Marginal plates magnified.
7. *OPHIURA WETHERELLI*, *p.* 32.
 - 7*a.* Restoration.
 - 7*b.* A specimen, natural size.
 - 7*c.* Portion of the upper surface of an arm.
- 8,9,10. *COLUMNS AND JOINTS OF PENTACRINITES SUBBASALTIFORMIS*, *p.* 34.



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